NRSC AM Compatibility Testing

Analog Performance in the Presence of Interferers

Testbed Description and Test Results

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XETRON
A SUBSIDIARY OF NORTHROP GRUMMAN CORPORATION

Xetron Corporation
460 W. Crescentville Road
Cincinnati, OH 45246

Table of Contents

List of Figures

1. Introduction

This document describes testing of iBiquity Digital's In Band On Channel (IBOC) Digital Audio Broadcast (DAB) system performed at Xetron Corporation. The testing was designed to satisfy tests outlined in the document "IBOC Laboratory Test Procedures – AM Band," which was provided to Xetron by the NRSC. Specifically, the testing performed at Xetron is known as Analog Compatibility testing, and is intended to investigate the impact of iBiquity's Hybrid AM DAB to existing AM services.

The tests were divided into two main parts: objective testing and subjective testing. In the objective testing, the audio Signal to Noise Ratios (SNRs) of several commercial AM receivers were measured for a variety of interference scenarios. The subjective tests involved digitally recording this audio for subsequent off-site subjective evaluation.

This document is divided into two primary sections: Testbed Description and Test Results. The testbed description is intended to document the testing in sufficient detail such that a third party could reproduce the results. The testbed description includes the Testbed Diagram, which shows all of the equipment interconnections to facilitate reconstruction of the testbed. Also included are Test Procedures, which describe, step-by-step, the procedures that were followed during the performance of the testing.

The Test Results section summarizes the objective measurements taken during the testing, and includes comments and observations regarding execution of the tests. The raw subjective test results, namely the original audio recordings, have been archived at Xetron.

2. Testbed Description

During the objective testing, the Xetron DAB testbed setup was used to collect accurate measurements of audio signals, such as Signal-to-Noise (SNR), audio output power, and distortion level, for each of the four test receivers. Subjective testing was also performed using this DAB testbed. In this portion of the testing, the testbed was used to make audio recordings to corroborate the objective results. Table 1 provides detailed information regarding the specific receivers used in both the subjective and objective testing.

Receiver Name	Model	Serial Number
NRSC Delphi Test Receiver	9394139	DDSTM103490268
NRSC Pioneer Test Receiver	KEH-1900	1256250092
NRSC Sony Test Receiver	CFD-S22	1192338
NRSC Technics Test Receiver	SA-EX110	GY8JA38798

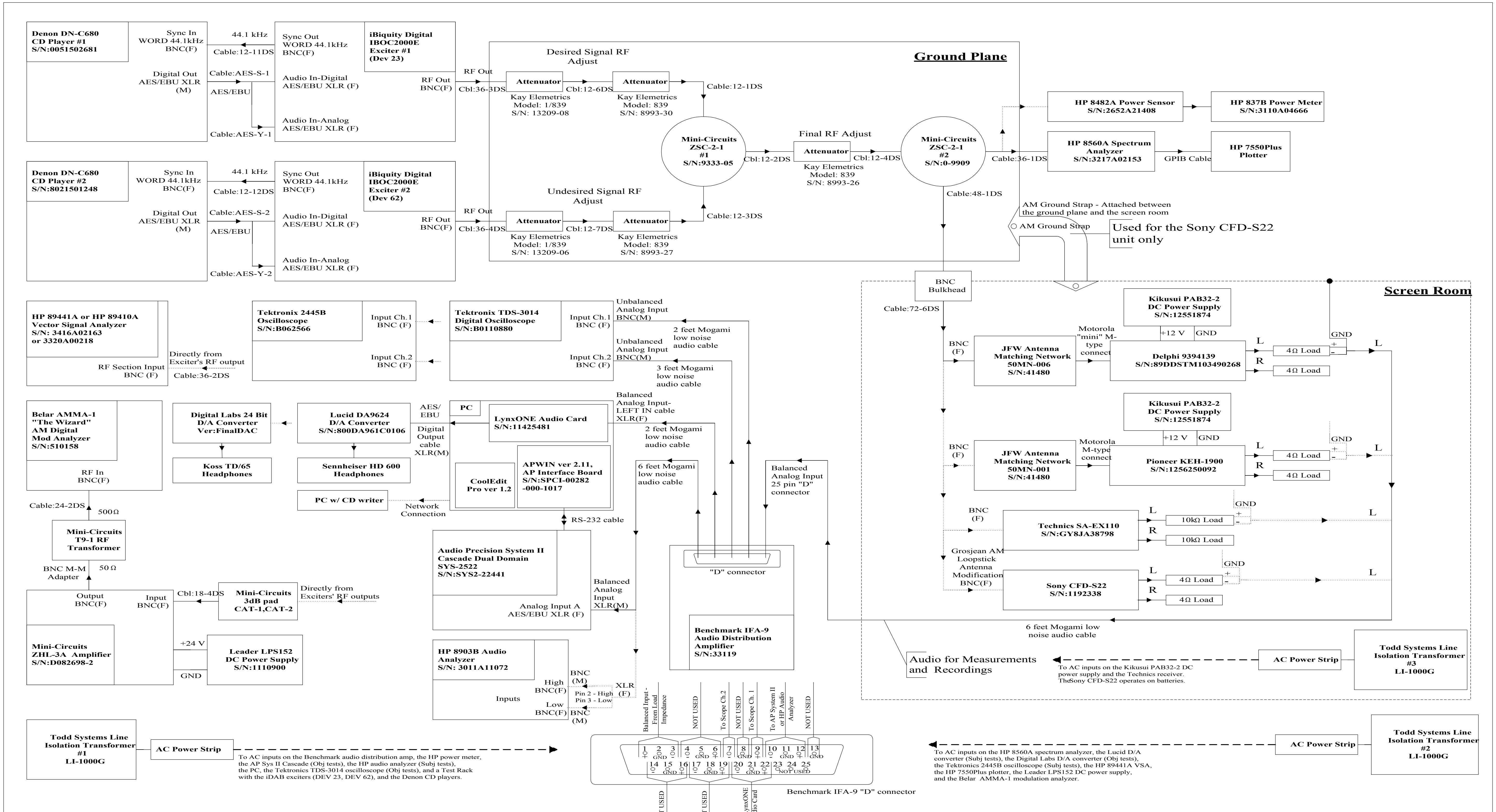
Table 1 – NRSC Test Receivers

Much of the equipment in the DAB testbed requires periodic calibration. Calibration of all of this equipment was maintained throughout the course of the testing. Calibration of this equipment is traceable to NIST, and calibration documentation is included in Attachment E.

In addition, the performance of some additional equipment in the testbed was characterized as deemed appropriate. This characterization information is also included in Attachment E.

Finally, the Xetron DAB testbed performance was verified daily by means of the proof of performance tests included in the calibration procedures. The results of these daily calibration tests are included in Attachment B.

2.1 Testbed Diagram



NRSC AM Band Analog Compatibility Testbed

2.2 Equipment

This section describes the equipment and software used in the NRSC testing. Section 2.2.1 is an exhaustive list of all equipment used in the test. Section 2.2.2 details the settings and configuration of all this equipment. In some cases, the actual hardware configuration is stored in software and recalled to configure the instrument properly prior to the testing. In these cases, the description included is not exhaustive, but provides some insight as to the measurement method used.

Section 2.2.3 describes the software used during the testing. This software ran under Windows 98 on the testbed PC.

2.2.1 Equipment List

Device	Model No.	Serial No.	Provider	Xetron Cal Barcode	Cal Date	Cal Due
1. Denon CD player #1	DN-C680	51502681	iBiquity	N/A	N/A	N/A
2. Denon CD player #2	DN-C680	8021501248	iBiquity	N/A	N/A	N/A
3. IBOC 2000E Exciter #1	2000e	DEV 23	iBiquity	N/A	N/A	N/A
4. IBOC 2000E Exciter #2	2000e	DEV 62	iBiquity	N/A	N/A	N/A
5. Double-shielded cables	RG 400U	See Cable List	iBiquity	N/A	N/A	N/A
6. Mini-circuits 1dB pad	CAT-1	19925	iBiquity	N/A	N/A	N/A
7. Mini-circuits 2dB pad	CAT-2	19911	iBiquity	N/A	N/A	N/A
8. Mini-circuits RF Amplifier	ZHL-3A	D082698-2	iBiquity	N/A	N/A	N/A
9. Leader DC Power Supply	LPS152	1110900	Xetron	11508	N/A	N/A
10. Mini-circuits RF Transformer	T9-1	N/A	Xetron	None	N/A	N/A
11. Belar AM Wizard	AMMA-1	510158	iBiquity	N/A	Daily	Daily
12. HP Vector Signal Analyzer	89410A	3320A00218	Xetron	11668	12/7/99	12/7/01
13. HP Vector Signal Analyzer	89441A	3416A02163	Xetron	12629	3/2/01	3/2/02
14. Kay Switchable attenuator	839	8993-26	iBiquity	14361	6/6/01	6/6/02
15. Kay Switchable attenuator	839	8993-27	iBiquity	14360	6/13/01	6/13/02
16. Kay Switchable attenuator	839	8993-28	iBiquity	14362	7/25/01	7/25/03
17. Kay Switchable attenuator	839	8993-29	iBiquity	14359	10/11/00	10/11/01
18. Kay Switchable attenuator	839	8993-30	iBiquity	14358	6/6/01	6/6/02
19. Kay Switchable attenuator	1/839	13209-06	iBiquity	16760	7/10/01	7/10/02
20. Kay Switchable attenuator	1/839	13209-08	Xetron	16758	6/13/01	6/13/02
21. Mini-circuits Splitter/Combiner #1	ZSC-2-1	9333-05	iBiquity	N/A	N/A	N/A
22. Mini-circuits Splitter/Combiner #2	ZSC-2-1	0-9909	iBiquity	N/A	N/A	N/A
23. HP Power Sensor	8482A	00443	Xetron	07857	3/22/01	3/22/03
24. HP Power Meter	437B	3110A04666	Xetron	07802	2/24/00	2/24/02
25. HP Spectrum Analyzer	8560A	3217A02153	Xetron	10239	8/17/00, 8/20/01	8/20/02
26. JFW Antenna match (for Delphi)	50MN-006	41480	iBiquity	N/A	N/A	N/A
27. JFW Antenna match (for Pioneer)	50MN-001	33038	iBiquity	N/A	N/A	N/A
28. NRSC Delphi Test Receiver	9394139	DDSTM103490268	NRSC	N/A	N/A	N/A
29. NRSC Pioneer Test Receiver	KEH-1900	1256250092	iBiquity	N/A	N/A	N/A
30. NRSC Sony Test Receiver	CFD-S22	1192338	iBiquity	N/A	N/A	N/A
31. NRSC Technics Test Receiver	SA-EX110	GY8JA38798	NRSC	N/A	N/A	N/A
32. Kikusui DC Power Supply	PAB 32-2	12551874	Xetron	11486	N/A	N/A
33. Dummy speaker/line-level loads	DALE	N/A	Xetron	None	N/A	N/A
34. Benchmark Distribution Amplifier	IFA-9	33119	iBiquity	N/A	N/A	N/A
35. HP Audio Analyzer	8903B	3011A11072	Xetron	07775	7/20/01	7/20/02
36. Audio Precision System II Cascade	SYS-2522	22441	iBiquity	N/A	4/10/01	4/10/02
37. Tektronix Oscilloscope	TDS 3014	B0110880	Xetron	14735	9/3/99, 9/14/01	9/14/03
38. Tektronix Oscilloscope	2445B	B062566	Xetron	10115	8/17/01	8/17/03
39. Lynx Studio Technology Audio Card	LynxONE	11425481	iBiquity	N/A	N/A	N/A
40. Audio Precision Interface Board	N/A	SPCI-00282-000-1017	iBiquity	N/A	N/A	N/A
41. DabLabPC	N/A	N/A	Xetron	13871	N/A	N/A
42. Lucid D/A Converter	DA9624	800DA961C0106	iBiquity	N/A	N/A	N/A
43. Sennheiser Headphones	HD 600	N/A	iBiquity	N/A	N/A	N/A
44. Digital Labs D/A Converter	N/A	N/A	iBiquity	N/A	N/A	N/A
45. Koss Headphones	TD/65	N/A	iBiquity	N/A	N/A	N/A
46. Todd Systems Isolation Transformers	LI-1000G	N/A	Xetron	None	N/A	N/A

Table 2 - Equipment List

2.2.2 Equipment Settings

Equipment configuration settings for all equipment listed in Section 2.2.1 are included below. Where settings are listed as test dependent, the appropriate setting is specified in the procedures.

1. and 2. Denon CD Players 1 and 2:

All settings at factory defaults, except:
- CD-R: TOC
- DENON 1: Program 1 ON

Sync settings:
- Sync: Word
- 29.97fps DRF
- LTC: OFF

3. and 4. IBOC 2000E Exciters 1 and 2:

Software Version--objective testing:
Ver. 5.1 except atmdh1h.exe
atmdh1h.exe
- Downloaded: 6/1/01 11:52 AM
- Filesize: 772,703 Bytes
- Description: Ties precomp on/off to DAB On/off button

Software Version--subjective testing:
Ver. 5.2 except atmdh1h.exe
atmdh1h.exe
- Downloaded: 9/19/01 10:44 AM
- Filesize: 772,703 Bytes
- Description: Ties precomp on/off to DAB On/off button

Configuration:
Analog gain: Test dependent
5 kHz LPF: Test dependent
DAB ON/OFF: Test dependent

BMUC Delay: 1024
Zero Analog Delay: DELAY ON
DC Offset: 0.00

5. Double-shielded cables: N/A
6. Mini-circuits 1dB pad: N/A
7. Mini-circuits 2dB pad: N/A
8. Mini-circuits RF Amplifier: N/A

9. Leader DC Power Supply:

Meter: Reference +25 V
Reference: Adjust for +24.0 V output

Tracking Ratio: Fixed
±1 Amp Current Limiters: Full CW

10. Mini-circuits RF Transformer: N/A

11. Belar AM Wizard:

Neg Settings:
- - Peak Mod: 100%
- - PPM Thresh: 10
- - PPM Dur: 10 ms

Pos Settings:
- + Peak Mod: 125%
- + PPM Thresh: 10
- + PPM Dur: 10 ms
- Norm High: 99%
- Norm Low: 90%
- Norm Thresh: 10
- Norm Dur: 10 ms
- Sentry: 0%
- Sentry: 30 sec.
- Pk Weight: OFF

Unit settings:
- Hold: 1.0 Sec.
- Time mode: Real
- Infinite: Test dependent
- Remote: OFF
- Mod Adj: +0.0%
- Calibrator: OFF

Car Settings:
- Mod Mode: Norm
- Car Thresh: 0%
- Car Time: 1 sec.
- Shift Thresh: 10%

12. <u>or 13. HP Vector Signal Analyzer</u>:

Instrument Mode:
- Scalar
- Receiver: 0 – 10 MHz selected

Frequency:
- Center Frequency: 1 MHz
- Span: 40 kHz
- Time Data: Zoom
- Step Size: Auto
- Signal Track: Off

Resolution BW/Window:
- RBW: 30 Hz
- RBW Coupling: Fixed
- RBW Mode: 1-3-10
- Detector: Sample
- Num Freq Pts: 3201

Range:
- Ch. 1 selected
- Ch. 1 range: 0 dBm
- Ch. 1 Auto range: off

Marker Function:
- Peak Track: Off
- Freq Counter: Off
- Demod Carrier: Off

Band Power Markers:
- Band Power Marker: On
- Band Left: Measurement-dependent
- Band Right: Measurement-dependent
- Band Power selected

Average:
- Average: On
- Num Averages: 18
- Average Type: RMS (video)
- Repeat Avg: Off
- Fast Avg: Off

14. <u>- 20. Kay Switchable attenuators</u>: Test dependent

21. <u>Mini-circuits Splitter/Combiner #1</u>: N/A
22. <u>Mini-circuits Splitter/Combiner #2</u>: N/A
23. <u>HP Power Sensor</u>: N/A

24. <u>HP Power Meter</u>:

All settings as preset except:
Ref Cal Factor and Sensor Data: As per sensor
Auto filter: ON
Freq: 1 MHz
Sensor: 2 (8482A)
HPIB: 13
Remote/Local: Local

25. <u>HP Spectrum Analyzer</u>:

All settings as preset except:
Center Frequency: 1 MHz
Span: 50 kHz
RBW: 300 Hz
Reference Level: -10 dBm
Detector: Normal
Additional settings: Test dependant

26. JFW Antenna match network (for Delphi): N/A
27. JFW Antenna match network (for Pioneer): N/A

28. NRSC Delphi Test Receiver:
Manual balance, fader, bass and treble: Center positions
Auto tone: Manual
Auto volume control: OFF

29. NRSC Pioneer Test Receiver:
Balance, fader, bass and treble: Center positions
Loudness: OFF

30. NRSC Sony Test Receiver:
Bass boost: OFF

31. NRSC Technics Test Receiver:
Balance, bass and treble: Center positions
Volume knob: Set to minimum

32. Kikusui DC Power Supply:
Voltage knobs: Adjust for +12.0 V
Current knob: Full CW
Grounding bar: Disconnected from negative terminal

33. Dummy speaker/line-level loads: N/A

34. Benchmark Distribution Amplifier: Potentiometers of active channels set for unity gain

35. HP Audio Analyzer:
Input grounding: FLOAT
Additional settings: Test dependent

36. Audio Precision System II Cascade:
Analog Analyzer Panel:
- Input Channel: Channel A
- Input Format: XLR-Bal, 100 kΩ
- Function Reading: Channel A selected
- THD+N Ratio Auto Range selected
- Detector: 8/sec, RMS
- BW: < 10Hz – 22 kHz
- BP/BR Filter Freq: Fixed, 1.0 kHz
- Filter: None
- References: dBrA: in dBV – Measurement Dependent

Digital Analyzer Panel:
- Analyzer: DSP Audio Analyzer (Analyzer)
- Input Channel: Channel A: HiRes A/D 65536
- Coupling: AC coupled
- Level: in Watts
- Frequency: in kHz
- Measurement Function: Amplitude
- Amplitude Auto Range selected
- Detector: 8/sec, Q-peak
- BW: < 10 Hz – $F_s/2$
- Filter: CCIR Weighting

Sweep Panel:
- Data1: DSP Anlr.Ampl.A
- Top: +100 dBrA
- Bottom: -100 dBrA
- Data2: DSP Anlr.Ampl.A

Top: +100 dBrA
Bottom: -100 dBrA
Source1: Time.External.SweepTime
Start: 0.00 sec
Stop: 20.00 sec
Steps: 10000
Stepsize: 2.00 msec
Pre-Sweep Delay: 0.00 sec
X-Y selected

Settling Panel:
Analog Analyzer: Ampl: 1.0% Tolerance, 100nV Floor, 3 Pts, 0.0 sec Delay, Algorithm-None
DSP: DSP Anlr.Ampl.A: 1.0% Tolerance, 1.0uV Floor, 3 Pts, 30 msec Delay, Algorithm – None

37. <u>Tektronix Oscilloscope</u>:
Inputs: DC coupled, 1 MΩ impedance
MATH: CH1 – CH2
Trigger: CH1
Additional settings: As desired

38. <u>Tektronix Oscilloscope</u>:
Inputs: DC coupled, 1 MΩ impedance
INVERT, ADD: Selected
Trigger: A Norm, CH1
Trigger Rej.: HF
Additional settings: As desired

39. <u>Lynx Studio Technology Audio Card</u>:
Analog Input:
Left channel slider at maximum
Right channel slider at minimum
Digital Input: Muted
Digital Output: Monitored
Sample Clock:
Source: Internal
Reference: Auto
Auto selection selected
Digital Format: AES/EBU
Trim: Test dependent
Monitor Source: Analog In

Levels option: Selected
In the Settings menu option:
Record Dither: None
Play Dither: None
Advanced:
Analog In HPF: Selected
Analog Out Auto Mute: Selected
Levels: Selected
Sync Start: Selected
Channel Lock: Selected

40. <u>Audio Precision Interface Board</u>: N/A

41. <u>DabLabPC</u>:
200 MHz Pentium
128 MB RAM
Network cable connected
Running Windows 98 Second Edition (Build 2222A)

42. <u>Lucid D/A Converter</u>:
Volume and Output Levels: As desired
Input select: AES/EBU

43. <u>Sennheiser Headphones</u>: N/A
44. <u>Digital Labs D/A Converter</u>: N/A

45. Koss Headphones: N/A

46. Todd Systems Line Isolation Transformers: Ground plugs defeated

2.2.3 Software Settings

<u>Cool Edit Pro</u>:

Buffer settings:	Version 1.2 (Build 2315)
Edit View: 16 sec.8 buffers	All other settings at default
MT Play: 1.5 sec./10 buffers	
MT Rec: 2 sec./10 buffers	

<u>APWin</u>:

APWin 2.11 (build 811)	All settings specified in test files

2.3 Signals

A number of RF and audio signals were used during the NRSC testing. For convenience, these are listed and described below.

2.3.1 RF Waveforms

For all testing, the desired carrier was placed at 1.00 MHz, and the interfering station placed at 10 kHz offsets therefrom. Each carrier was modulated with one of the audio waveforms listed in Section 2.3.2, according to the test being performed. When a hybrid RF signal was required, DAB was enabled on the exciter's front panel. This activated the DAB carriers, which were added to the analog modulated waveform by the exciter.

With DAB off, the peak positive modulation was not allowed to exceed +125%, and the peak negative modulation was not allowed to exceed –100% (pinchoff). Because all of the modulating audio was known beforehand, the appropriate scaling for the analog audio to achieve the desired modulation was determined directly. Attachment C describes this procedure in detail.

The resultant modulation percentage was verified daily using a modulation monitor. In addition, the spectral containment of the modulated carrier with various modulation was investigated to insure that there were no significant out-of-band emissions.

2.3.2 Baseband (audio) Waveforms

Full Scale 1kHz Tone:
This track consists of a stereo, unprocessed 1 kHz sinusoid, 30 seconds in duration, which utilizes the entire dynamic range of the CD player. The tone was generated using the MATLAB code below, and subsequently written to CD in stereo 16 bit, 44.1 kHz audio format.

```
fs=44100;
a=cos(2*pi*1000*[0:1/fs:30]')*[1 1];
wavwrite(a,fs,'fullscale1khz.wav');
```

Silence:
The silence track is a thirty second track of all zeros; that is, silence with no DC offset. The file was generated using the code below (which follows that above). The silence was then written to CD in stereo 16 bit, 44.1 kHz audio format.

```
a=a*0;
wavwrite(a,fs,'silence.wav');
```

All Minus Ones:
A track of continuous "minus ones," the lowest representable sample in CD audio format, was used for suppression of the main carrier during calibration. This 31 second track was generated in MATLAB as follows:

```
fs=44100;
a=-ones(44100*31,2);
wavwrite(a,fs,'allminusones.wav');
```

The track was written to CD in stereo 16 bit, 44.1 kHz audio format.

Processed Pink Noise:
The modulating audio of the interferer in the objective testing was processed pink noise. For convenience, the pink noise files were pre-processed—that is, they were processed once and digitally recorded. These recordings were then played back for subsequent testing.

The recordings were generated by passing pink noise through an Orban Optimod 9200 and digitally recording the output signal using a MultiWav audio card. The pink noise was generated by an Audio Precision System Two configured as follows:

Digital Generator:
- Wfm: Noise, Pink

Amplitude:
- Ch. A = 1.000 FFS
- Ch. B = 1.000 FFS

Outputs: ON
Ch. A: ON
Ch. B: ON
Dither type: None

Digital I/O Panel:
- Output:
  - Format: XLR (Bal)
  - Int. Sample Rate: 44.1000 kHz
  - Voltage: 5.000 Vpp
  - Resolution: 24 Bits
  - Pre-emphasis: off
  - Jitter Generation: off

The Orban 9200 settings were as follows:

Processing:
- Preset: General Purpose Medium
- HF Curve: NRSC

Setup:
- INPUT: Digital
- POS PEAK: 125%

BANDWIDTH:
- HP FLTR: 50 Hz
- LP FLTR: NRSC or 4.5 kHz

Digital Input:
- DI MODE: DIG-L
- DI REV VU: -11.0 dBFS
- DI REF PPM: -3.0 dBFS

Digital Output:
- DO 100%: -3.6 dBFS
- DO RATE: 44.1 kHz
- DO SYNC: Internal
- HF DELAY: Off
- HF Shelf: off

The MultiWav audio card was configured as follows:

Options:	I/O:
Dig out carrier: 44.1 kHz	Input Source and Format: AES/EBU
Analog Output: Enabled	Output Format: AES/EBU Elect. & Optical
Playback Sync: To Internal Clock	Word Clock Config: BNC is Disabled. Header is WORD CLK IN
Warn on No DMA Channels: Selected	
Warn on Freq mismatch: Selected	

The Optimod's 4.5 kHz LP filter was used when making the 4.5 kHz Pink Noise recording, and the NRSC LP filter was used for the 9.5 kHz Pink Noise recording. The recordings are both approximately 2 minutes in length. These files were written to CD in mono 16 bit, 44.1 kHz audio format for use in the objective testing.

Processed NRSC Subjective Test Cuts:
In the subjective testing, both the desired and undesired channels were modulated with selected audio cuts. Like the pink noise tracks for the objective tests, these audio cuts were processed prior to the testing. The recordings were generated by passing the unprocessed audio cuts through an Orban 9200, and digitally recorded using the LynxOne audio card.

Desired (host) modulation:
The audio source was a "special" CD, each track of which contained one of the NRSC subjective test cuts repeated twice. The purpose of this repetition was to prime the Optimod's AGC on the first pass, and to record the processed audio on the second pass. This prevented AGC transients in the processed audio which have been noticed in the past.

Undesired (interferer) modulation:
The interfering station was modulated with the same audio for all of the subjective testing: the processed "Shania" cut. An extended interferer cut was created by looping one 15.8 second segment of unprocessed Shania for 10 minutes, 1.5 seconds. This extended cut was then written to CD and used as the audio source for the pre-processing chain.

For both the desired and undesired pre-processing, the unprocessed audio was played using DENON CD player #2, and the AES/EBU signal passed through the Optimod 9200, which was configured as follows:

<u>Voice cuts</u>:

Processing:
- Preset: News
- HF Curve: NRSC

Setup:
- INPUT: Digital
- POS PEAK: 125%

BANDWIDTH:
- HP FLTR: 50 Hz
- LP FLTR NRSC or 4.5 kHz

Digital Input:
- DI MODE: DIG-L
- DI REV VU: -11.0 dBFS
- DI REF PPM: -3.0 dBFS

Digital Output:
- DO 100%: -3.6 dBFS
- DO RATE: 44.1 kHz
- DO SYNC: Internal
- HF DELAY: Off
- HF Shelf: off

<u>Classical cuts</u>:

Processing:
- Preset: Fine arts
- HF Curve: NRSC

Setup:
- INPUT: Digital
- POS PEAK: 125%

BANDWIDTH:
- HP FLTR: 50 Hz
- LP FLTR NRSC or 4.5 kHz

Digital Input:
- DI MODE: DIG-L
- DI REV VU: -11.0 dBFS
- DI REF PPM: -3.0 dBFS

Digital Output:
- DO 100%: -3.6 dBFS
- DO RATE: 44.1 kHz
- DO SYNC: Internal
- HF DELAY: Off
- HF Shelf: off

<u>Rock and Voice-over cuts</u>:

Processing:
- Preset: Music Heavy
- HF Curve: NRSC

Setup:
- INPUT: Digital
- POS PEAK: 125%

BANDWIDTH:
- HP FLTR: 50 Hz
- LP FLTR NRSC or 4.5 kHz

Digital Input:
- DI MODE: DIG-L
- DI REV VU: -11.0 dBFS
- DI REF PPM: -3.0 dBFS

Digital Output:
- DO 100%: -3.6 dBFS
- DO RATE: 44.1 kHz
- DO SYNC: Internal
- HF DELAY: Off
- HF Shelf: off

The AES/EBU outputs of the Orban were connected to the Digital Input of the LynxOne audio card for recordings. Cooledit Pro was used to perform the recordings. Once the processed recordings were completed, they were each cropped to the section of interest. These cropped files were then written to CD in stereo 16 bit, 44.1 kHz format for use in the subjective testing.

3. Test Procedures

3.1 Common Test Procedures

Several procedures are used repeatedly in both the calibration and testing procedures. For convenience, these detailed procedures are listed once in this section, and referenced by name or section thereafter.

3.1.1 RF Power Measurements

This test procedure is used to measure RF power level of one exciter at the end of the RF signal chain, just prior to the receiver. The test is performed using the HP 437B power meter and the HP 8482A power sensor, configured as described in Section 2.2.2, Equipment Settings.

1. Before connecting an RF signal to the input of the power sensor, press the ZERO button on the power meter to zero the unit prior to taking a measurement.
2. Disconnect Splitter #2 from the cable leading to the BNC bulkhead, and terminate this tap with a 50Ω terminator.
3. Disconnect the second exciter's cable from Splitter #1. Terminate both the unused tap on Splitter #1 and the disconnected cable with 50Ω terminators.
4. Turn off the DAB carriers of the exciter, if necessary. Stop or pause any program material playing on the corresponding CD player. This will result in an unmodulated analog carrier.
5. Using cable 36-1DS, connect Splitter #2 to the power sensor. Read the power measurement to the nearest hundredth of a dB.

3.1.2 Audio SNR Measurements

Measurement of audio SNR can be performed with either of two measurement devices: the AP System II Cascade, or the HP Audio Analyzer. For the objective testing, the AP System II was used; for the subjective testing, the HP was used.

<u>Measurement of Audio SNR using the System II Cascade</u>:
1. Cue and play the Full Scale 1kHz Tone track on the appropriate CD player. When making SNR measurements with an interferer present, simultaneously cue and play the appropriate processed pink noise track on CD player #2.
2. After 5 seconds, click on the "Go" button in the Sweep panel to start taking signal level measurement data. The Data Editor panel will display the recorded signal level measurements, and when the sweep is done it will calculate the average of the signal level measurements in dB. To set the zero reference level for the SNR measurement, enter the averaged value displayed in the Data Editor panel, into the "dBrA" box which is in the "Reference" section of the Analog Analyzer panel.
3. Cue and play the Silence track. When making SNR measurements with an interferer present, simultaneously cue and play the appropriate processed pink noise track on CD player #2. After 5 seconds, click on the "Go" button in the Sweep panel to start taking SNR

measurement data. The Data Editor panel will display the recorded SNR measurements, and when the sweep is done it will calculate the average SNR in dB.

4. Save the raw and averaged SNR measurements by selecting File → Export → ASCII Data. The data will be saved as .adx files that can be opened in Excel.

Measurement of Audio SNR Using the HP Audio Analyzer:

1. Select the CCIR weighting filter.
2. Place the instrument in Quasi-peak detector mode by entering 5.7 SPCL, followed by the AC LEVEL button.
3. Cue and play the Full Scale 1kHz Tone track on the appropriate CD player.
4. While the tone is playing, press the Ratio button twice to zero the measurement. It may be necessary to press the LOG/LIN button to change the readout to dB.
5. Cue and play the Silence track.
6. Visually average the SNR, if necessary, to the nearest tenth of a dB.

3.1.3 IBOC Exciter Shutdown

1. Enter the exciter's diagnostic menu.
2. Change the Boot Mode setting to "Network," if necessary.
3. Select System Shutdown.
4. If the exciter was shut down in network mode, connect its monitor and keyboard.
5. Reset the exciter by powering it off briefly, and then back on. If the exciter is being started in network mode, it will be necessary to manually load the DSPs from the DOS interface.

3.1.4 IBOC Exciter Reset

Upon restart of the exciter, which is necessary following a change of frequency, it is necessary to verify several menu settings before continuing with tests.

1. After the exciter has finished loading its DSPs, enter its diagnostic menu.
2. Verify that the BMUC Delay is set for 1024 samples.
3. Verify that the Zero Analog Delay option is set to "ON."
4. Verify that the analog audio gain is set correctly; if it is not, enter the correct gain. The appropriate gain depends on the test being performed.
5. Set the 5 kHz LPF to the desired state; again, the appropriate setting depends on the test being performed.
6. Exit the diagnostic menu.

3.1.5 Modulation Monitor Configuration/Calibration

1. Under the "UNIT SETTINGS" menu, disable the "INFINITE" setting. Go to "CALIBRATOR-OFF" and set it to "ON". The NEG MODULATION display should read "100" and the NEG PEAK, NEG PPM, and NORMAL LED's should light up.
2. Exit this menu, and go to the "POS MOD" menu display; it should read 100%. Change to the "CAR LEVEL" menu display, it should read 100%. This indicates the positive modulation and the carrier level functions are correctly calibrated.
3. Go back to the "UNIT SETTINGS" menu and turn the calibrator off.

3.1.6 Audio Recording

1. In Cool Edit Pro, open a new mono file with 44.1 kHz sampling rate.
2. Click or select record to begin recording audio.
3. When making recordings with an interferer present, cue and play the appropriate undesired cut on CD player #2. The interferer may be started anywhere within its 10 minute length, provided the track does not end during the recording.
4. Cue and play the appropriate desired cut on CD player #1.
5. After the cuts have finished playing, stop the recording.
6. Save the recording using the following nomenclature: *rx*_RFM_*DABstate*_*int*_*du*.wav, where:

   rx is one of Delphi, Technics, Pioneer, or Sony,
   RFM indicates that the recording was made at the moderate RF level,
   DABstate is one of DABOn or DABOff,
   int is one of L1, L2, U1, U2, or Host, and
   du is one of NA, 0DU, 7.5DU, 15DU, 22.5DU, or 30 DU.

3.2 Daily Calibration Procedure

The following procedure was followed to verify testbed integrity during the NRSC testing. The calibration procedure references several Common Test Procedures, which appear in italics in the text below. These Common Test Procedures are described in Section 3.1 of this document.

3.2.1 Receiver and Test Equipment Warm Up

Allow at least 60 minutes of warm up time for all the equipment, including the DUTs.

3.2.2 IBOC Exciter Setup

1. If necessary, change the transmit frequency of both exciters to 1.00 MHz by depressing the "FREQ" button for several seconds, and then entering the frequency.
2. If a retune was necessary, perform the *IBOC Exciter Shutdown* procedure for each exciter. The undesired exciter should be shutdown in Network Boot Mode, as detailed in Section 3.1.3.
3. Perform the *IBOC Exciter Reset* procedure (Section 3.1.4) for each exciter, to verify both are configured correctly. The analog gain settings should be 1.00 and the 5 kHz LPFs should be set to "OFF."

3.2.3 RF Signal Power Levels

1. Remove all attenuation from the signal path.
2. Measure the unmodulated RF signal power being output by the undesired exciter according to the *RF Power Measurement* procedure (Section 3.1.1). The level should be approximately –13 dBm. Record the power measurement in the Calibration Results template.
3. Add the necessary attenuation, using the appropriate Kay Elemetrics 1/839 attenuator, to produce an RF level as near as possible to –14.00 dBm as measured by the power meter. Record the attenuator switch settings and the resultant RF power level in the Calibration Results template.
4. Repeat steps 1 and 2 for the desired exciter.

3.2.4 DAB Power Level Measurement

1. Using the undesired exciter's CD player, cue the cut titled "All minus ones." This cut suppresses the main (analog) carrier, which would otherwise dominate power measurements of the innermost DAB carriers.
2. Turn on the DAB carriers using the DAB On/off button located on the exciter's front panel.
3. Configure the VSA as described in Section 2.2.2 by loading the setup file 'setup.sta'.
4. Connect the undesired exciter's RF output directly to the vector signal analyzer using cable 36-2DS, a male-to-male connector, and another short BNC cable.
5. Type 'diag21k' on the exciter's keyboard to enter diagnostic mode. Type 'fx coreonly' and press enter to load a DAB carrier mask with only the core carriers turned on.

6. Play the "All minus ones" cut, and restart the VSA averaging. Make certain that the main carrier remains off for the duration of the measurement. When the averaging is complete, reposition the left and right Band Power Markers to 1.005 MHz and 1.02 MHz, respectively, and record the band power measurement.
7. Type 'fx outerenh' and press enter to load a DAB carrier mask with only the outer enhanced carriers turned on. Play the "All minus ones" cut, and restart the VSA averaging. When the averaging is complete, reposition the left and right Band Power Markers to 1.0 MHz and 1.015 MHz, and record the band power measurement.
8. Type 'fx innerenh' and press enter to load a DAB carrier mask with only the inner enhanced carriers turned on. Play the "All minus ones" cut, and restart the VSA averaging. When the averaging is complete, reposition the right Band Power Marker to 1.01 MHz, and record the band power measurement.
9. Turn DAB off by pressing the DAB On/off button on the exciter's front panel. Measure the power of the unmodulated carrier by placing a marker on the peak of the VSA's trace. No averaging is required for measurement of the main carrier.
10. Type 'fx p5ramp' and press enter to reload the default DAB carrier mask.

3.2.5 RF Spectrum

Generate RF spectrum plots as detailed below. Collect these measurements from each exciter's RF output. These measurements are used to check for spurious signals.

1. Configure the spectrum analyzer as described in Section 2.2.2.
2. Disconnect the second exciter's cable from Splitter #1. Terminate both the unused tap on Splitter #1 and the disconnected cable with 50Ω terminators.
3. Using cable 36-1DS, connect Splitter #2 to the spectrum analyzer. Enable MAX HOLD under the trace menu, and measure the unmodulated analog carrier for 3 minutes.
4. Save the trace to the Spectrum analyzer's register, and plot out the trace using the HP plotter. Check the plot for any unusual spurious emissions. Label the plot with the test date and plot number. Record the plot number in the Calibration Results template.
5. Turn on the DAB carriers using the DAB on/off button on the exciter's front panel.
6. Clear the trace, and then re-enable the MAX HOLD function. Allow the trace to run for 3 minutes.
7. Save the trace to the Spectrum analyzer's register, and plot out the trace using an HP plotter. Check the plot for any unusual spurious emissions. Label the plot with the test date and plot number. Record the plot number in the Calibration Results template.
8. Clear the trace to return the Spectrum Analyzer to its original state.

3.2.6 Modulation Levels

Configure the AM Wizard Modulation Monitor as described in Section 2.2.2 and perform calibration as described in Section 3.1.5. For each exciter, measure the modulation levels as described below:

1. Turn the DAB carriers off on the exciter to be measured using the DAB On/off button on the front panel.
2. Turn on the DC power supply of the ZHL-3A amplifier, and verify that it is set to +24 volts. Connect the exciter's RF output to the ZHL-3A amplifier's input through the Mini-Circuits 3 dB pad, using cable 36-3DS or 36-4DS.
3. Use the modulation monitor's front panel controls to select the "CAR LEVEL" menu. The display will indicate the carrier level of the input RF signal. Adjust the RF level control potentiometer (R1) on the rear of the Wizard until a 100% carrier level is measured. Return the display to POS MOD.
4. Play the track titled "Full Scale 1kHz Tone" on the CD player of the exciter being tested. Record the positive and negative modulation readings in the Calibration Results template.
5. Adjust the exciter for the Analog Gain and 5 kHz LPF settings shown in the table below. For a description of how the Analog Gain settings were determined, see Attachment C. Cue the appropriate audio cut as shown in the table below.

	5 kHz LPF	Analog gain	Audio Cut
Desired Exciter – Objective Tests	N/A	N/A	N/A – Only modulation is 1kHz tone
Undesired Exciter – Objective Tests	On	1.480237	1 min. of 4.5 kHz Pink Noise
Desired Exciter – Subjective Tests	Off	1.445498	First 3 min. of Desired CD
Undesired Exciter – Subjective Tests	Off	1.445498	1.5 min. of 4.5 kHz Shania 1.5 min. of 9.5 kHz Shania

Table 3 - Audio Used for Modulation Level Measurements

6. Use the buttons on the front panel of the Modulation Monitor to select the "UNIT SETTINGS" menu. Find the "INFINITE" option, and set it to "ON." Exit the menu and scroll to the "POS MOD" measurement display.
7. Play the appropriate audio cut, as shown in the table above. When the cut is complete, record the measured positive and negative modulation levels from the front panel of the AM Wizard. The levels should be near +125% and -99%, respectively.
8. Reset the infinite hold measurement by setting "INFINITE" to "OFF" under the "UNIT SETTINGS" menu.
9. Turn off the +24 V power supply.

3.3 Receiver Calibration Procedure

The calibration measurements outlined below were performed on each of the four NRSC receivers individually, immediately prior to starting the NRSC AM Compatibility tests on that particular receiver.

3.3.1 Receiver Setup

1. Place the DUT in the screen cage, and apply power. For the automotive units, set the DC power supply voltage for +12.0 V with a calibrated multimeter. For the Sony boombox, insert new batteries in the DUT, and unplug the isolation transformer from its wall outlet.
2. Verify that the settings of the DUT are as specified in Section 2.2.2. Connect the outputs of the DUT as shown in the Testbed Diagram in Section 2.1.
3. Allow the receiver to warm up for a period of one hour prior to continuing the test, unless the receiver has been warmed up (outside the screen cage) beforehand.

3.3.2 IBOC Exciter Setup

1. If necessary, set the transmit frequency of the undesired exciter to 1.00 MHz by depressing the "FREQ" button for several seconds, and then entering the frequency.
2. If a retune was necessary, perform the *IBOC Exciter Shutdown* procedure for the undesired exciter, as detailed in Section 3.1.3. The exciter should <u>not</u> be shutdown in Network Boot Mode.
3. Perform the *IBOC Exciter Reset* procedure (Section 3.1.4) for each exciter, to verify both are configured correctly. The analog gain settings should be 1.00 and the 5 kHz LPFs should be set to "OFF."

3.3.3 RF Signal Power Level

1. Reconnect Cable 36-4DS to the appropriate attenuator, if necessary.
2. Remove all attenuation from the undesired exciter's RF signal path, except that of the 1/839 attenuator. Set the attenuation of the 1/839 attenuator to that determined in the Daily Calibration Procedure (Section 3.2).
3. Measure the unmodulated RF signal power being output by the undesired exciter according to the *RF Power Measurement* procedure (Section 3.1.1). If necessary, adjust the attenuation of the appropriate Kay Elemetrics 1/839 attenuator to produce an RF level nearer to –14.00 dBm.
4. If an adjustment is made, record the attenuator switch settings and the resultant RF power level in the Calibration Results template.
5. Reconnect cable 36-1DS to the spectrum analyzer when the measurement is complete.

3.3.4 Audio Output Power Level

1. Re-connect the output of Splitter #2 to the BNC Bulkhead leading to the DUT.

2. Add the necessary attenuation in the Final RF Adjust attenuator to achieve a Strong RF level for the DUT (the appropriate levels are listed in Attachment A).
3. Adjust the volume setting of the DUT to achieve output power as close as possible to the levels in Table 4, without exceeding these levels. The procedure for performing the audio power measurement is detailed at the end of this section.
4. Record the measured power level in the Calibration Results template.
5. Add 14 dB of attenuation to the Final RF Adjust attenuator and repeat the measurement at this moderate RF level.

For the objective tests, these measurements were performed using the Audio Precision System II Cascade. For the subjective tests, the HP Audio Analyzer was used.

Measurement of Audio Power Using the System II Cascade:
1. In APWin, load the test file named '*AMCompTests-SNR.at2c*.'
2. Using CD player #2, play the track with an unprocessed full-scale 1 kHz tone. The audio output power level, in Watts, as measured by the Audio Precision System II Cascade, will be displayed in the "Level" meter in the Analog Analyzer panel.

This audio output power level is referenced to the load impedance value given in the "Watts" window of the "Reference" section in the Analog Analyzer panel. For the Pioneer, Delphi, and Sony, use a load impedance of 4Ω. For the Technics, use a load impedance of 10kΩ.

Measurement of Audio Power Using the HP Audio Analyzer:
1. Enable the audio analyzer's 30 kHz LPF by pressing the labeled button on the front panel, if necessary.
2. De-select the CCIR weighting filter, if necessary.
3. Continuously play the 1 kHz tone track on the CD player.
4. Place the instrument into power measurement mode by entering 19.4 SPCL. The readout will display the measured power into a 4Ω load. For the Technics, this is not the actual output power, but the power can be calculated based on this measurement and knowledge of the impedance used in the testing.

Delphi automotive unit: 1 Watt (2 V_{rms}) into 4Ω.
Pioneer automotive unit: 1 Watt (2 V_{rms}) into 4Ω.
Technics home unit: N/A (Line level outputs used)
Sony portable unit: 0.25 Watt (1 V_{rms}) into 4Ω.

Table 4 - Audio Output Levels

3.3.5 Audio Distortion Level

1. Measure the audio distortion at this RF level. Record the measurement in the calibration results template. The procedure for performing the Audio Distortion Level measurement is included at the end of this section.

2. Change the undesired exciter's analog gain to 0.80 and repeat step 1. Set the analog gain back to 1.00 when the measurement is complete.
3. Remove 14 dB of attenuation from the Final RF Adjust attenuator and repeat Steps 1 and 2 at the Strong RF level.

For the objective tests, these measurements were performed using the Audio Precision System II Cascade. For the subjective tests, the HP Audio Analyzer was used.

<u>Measurement of Audio Distortion Using the System II Cascade</u>:
The distortion level, in percent, is displayed in the "Function Reading" section of the Analog Analyzer panel when the "THD+N Ratio" selection is made in the drop down menu.

<u>Measurement of Audio Distortion Using the HP Audio Analyzer</u>:
Continuously play the 1 kHz tone track on the CD player.
Select the distortion measurement by pressing the DISTN button. It may be necessary to press the RATIO or LOG/LIN buttons to switch the reading to % distortion. The distortion is displayed in the instrument readout.

3.3.6 Analog SNR Proof of Performance

For the objective tests, these measurements were performed using the Audio Precision System II Cascade. For the subjective tests, the HP Audio Analyzer was used.

1. Add 14 dB of attenuation to the Final RF Adjust attenuator to achieve a Moderate RF level. At this moderate RF level, perform the *Audio SNR Measurement* according to the procedure in Section 3.1.2. Record the measurement in the Calibration Results template.
2. *Objective testing only: Remove 14 dB of attenuation from the Final RF Adjust attenuator and Perform the* Audio SNR Measurement *procedure detailed in Section 3.1.2. Record the measurement in the Calibration Results template. Add 14 dB of attenuation to return to the moderate RF level.*
3. Add 14 dB of attenuation to the Final RF Adjust attenuator to achieve a Weak RF level.
4. Perform the *Audio SNR Measurement* according to the procedure in Section 3.1.2. Record the measurement in the Calibration Results template.

3.3.7 Recording Proof of Performance

The Recording Proof of Performance is necessary only when performing the Subjective Testing, because no recordings are made during the Objective Tests and the Lynx One card is not used.

Subjective testing only:
1. *Remove 28 dB of attenuation from the Final RF Adjust attenuator to obtain the appropriate strong RF level for the particular DUT.*
2. *Configure the Lynx One Audio Card as described in Section 2.2.2. Set the mixer's input trim level for –10 dBV.*
3. *Using the appropriate CD player, cue and play the Full Scale 1 kHz Tone track.*

4. *Using the Cool Edit Pro audio utility software, start a recording by pressing the record button.*
5. *Zero the HP Audio Analyzer as described in Step 4 of Section 3.1.2.*
6. *Cue and play the Silence cut. Visually average the SNR reading of the HP Audio Analyzer to the nearest tenth of a dB, and record this measurement in the Calibration Results template.*
7. *Once a reading has been obtained, stop the recording in Cool Edit Pro. Save the audio file, using a descriptive naming scheme to properly identify the recording at a later time.*
8. *Connect the Left Analog Outputs of the Lynx One Audio Card to the HP Audio Analyzer's input.*
9. *Play back the recording using the Cool Edit Pro audio utility software. Zero the audio level for the SNR measurement while the tone is playing, as described in Step 4 of Section 3.1.2. While the silence is playing, visually average the SNR reading of the HP Audio Analyzer to the nearest tenth of a dB, and record this measurement in the Calibration Results template.*
10. *Compare the measurements taken in Steps 7 and 10 to verify the integrity of the recording equipment.*

3.3.8 Noise Floor Check

In the subjective testing, the Lucid DA9624 D/A Converter and the Sennheiser HD600 headphones were used. For the objective testing, the digitalLabs AES converter and KOSS headphone combination was used.

1. Add the necessary attenuation to the Final RF Adjust attenuator to obtain the weak RF level for the particular DUT.
2. Using the CD player, play the silence track continuously.
3. Using the headphones, which are connected to the digital outputs of the LynxONE audio card through the AES/EBU converter box, listen to the noise floor of the test setup including the test receiver for a few minutes.
4. Make a note of any audible abnormalities. For the Sony boombox, connecting the RF Ground Strap shown in the testbed diagram may eliminate any audible 60 Hz hum.

3.3.9 Saving the Calibration Results Template

Save the completed daily Calibration Results template. Use a descriptive naming scheme sufficient to retrieve these results at a later date.

3.4 Objective test procedure

The following procedure was followed to perform the NRSC Objective Testing. Execution of this procedure follows that of the Daily Calibration Procedure (Section 3.2) and the Receiver Calibration Procedure (Section 3.3).

Host Compatibility:

1. Remove all attenuation from the undesired exciter's RF signal path, except that of the 1/839 attenuator. Set the attenuation of the 1/839 attenuator to that determined in the Daily Calibration Procedure (Section 3.2).
2. Measure the unmodulated RF signal power being output by the undesired exciter according to the *RF Power Measurement* procedure (Section 3.1.1). If necessary, adjust the attenuation of the appropriate Kay Elemetrics 1/839 attenuator to produce an RF level nearer to –14.00 dBm. If an adjustment is made, record the attenuator switch settings and the resultant RF power level in the Calibration Results template.
3. Reconnect splitter #2 to the BNC bulkhead. Add the appropriate attenuation to the Final RF Adjust attenuator to achieve a moderate RF level for the particular DUT. The RF levels to be used are included in Attachment A.
4. For the analog host compatibility testing, the DAB should be turned "OFF" using the DAB on/off button, and the 5 kHz LPF should be set to "OFF".
5. At this moderate RF level, perform the *Audio SNR Measurement* according to the procedure in Section 3.1.2. Record the measurement in the NRSC AM Compatibility Test Results template.
6. For the hybrid host compatibility testing, the DAB should be turned "ON" using the DAB on/off button, and the 5 kHz LPF should be set to "ON".
7. Perform the *Audio SNR Measurement* according to the procedure in Section 3.1.2. Record the measurement in the NRSC AM Compatibility Test Results template.

Analog Compatibility in the presence of interferers:

1. Retune the undesired exciter to the interferer frequency, shutdown the exciter, and restart it as described in Sections 3.1.3 and 3.1.4. The exciter should not be shut down in Network mode. The analog gain of the undesired exciter should be set to 1.480237 and the 5 kHz LPF turned ON.
2. Remove all attenuation from the desired exciter's RF signal path, except that of the 1/839 attenuator. Set the attenuation of the 1/839 attenuator to that determined in the Daily Calibration Procedure (Section 3.2).
3. Measure the unmodulated RF signal power being output by the desired exciter according to the *RF Power Measurement* procedure (Section 3.1.1). If necessary, adjust the attenuation of the appropriate Kay Elemetrics 1/839 attenuator to produce an RF level nearer to –14.00 dBm. If an adjustment is made, record the attenuator switch settings and the resultant RF power level in the Calibration Results template.

4. Repeat steps 2 and 3 above for the undesired exciter and RF signal path. Reconnect the outputs of the desired and undesired RF adjust attenuators to the Mini-Circuits ZSC-2-1 combiner/splitter #1.
5. Turn the undesired exciter's DAB carriers on.
6. Add the appropriate attenuation to the Final RF Adjust attenuator to achieve a moderate RF level for the particular DUT. The RF levels to be used are included in Attachment A.
7. For the 3rd adjacent interference scenario, remove 10 dB of attenuation from the final RF adjust attenuator and add 10 dB to the desired RF adjust attenuator to obtain a –10 dB D/U ratio.
8. At this moderate RF level, perform the *Audio SNR Measurement* according to the procedure in Section 3.1.2. Use the 4.5 kHz processed pink noise cut to modulate the undesired signal. Record the measurement in the NRSC AM Compatibility Test Results template.
9. Add 15 dB of attenuation to the undesired RF adjust attenuator and Repeat step 8.
10. Add 15 dB of additional attenuation to the undesired RF adjust attenuator and Repeat step 8.
11. Remove 30 dB of attenuation from the undesired RF adjust attenuator. Turn the undesired exciter's DAB carriers off and turn the 5 kHz LPF off.
12. At this moderate RF level, perform the *Audio SNR Measurement* according to the procedure in Section 3.1.2. Use the 9.5 kHz processed pink noise cut to modulate the undesired signal. Record the measurement in the NRSC AM Compatibility Test Results template.
13. Add 15 dB of attenuation to the undesired RF adjust attenuator and Repeat step 12.
14. Add 15 dB of additional attenuation to the undesired RF adjust attenuator and Repeat step 12.
15. Repeat steps 1-14 for each of the interferers shown in the table below.

Test Scenario		
Scenario	Interferer Type	D/U, dB
Analog Host	N/A	N/A
Hybrid Host	N/A	N/A
Upper 1st Adjacent Interferer	Analog	+0
	Analog	+15
	Analog	+30
Upper 1st Adjacent Interferer	Hybrid	+0
	Hybrid	+15
	Hybrid	+30
Lower 1st Adjacent Interferer	Analog	+0
	Analog	+15
	Analog	+30
Lower 1st Adjacent Interferer	Hybrid	+0
	Hybrid	+15
	Hybrid	+30
Upper 2nd Adjacent Interferer	Analog	+0
	Analog	+15
	Analog	+30
Upper 2nd Adjacent Interferer	Hybrid	+0
	Hybrid	+15
	Hybrid	+30
Lower 2nd Adjacent Interferer	Analog	+0
	Analog	+15
	Analog	+30
Lower 2nd Adjacent Interferer	Hybrid	+0
	Hybrid	+15
	Hybrid	+30
Upper 3rd Adjacent Interferer	Analog	-10
	Analog	+5
	Analog	+20
Upper 3rd Adjacent Interferer	Hybrid	-10
	Hybrid	+5
	Hybrid	+20
Lower 3rd Adjacent Interferer	Analog	-10
	Analog	+5
	Analog	+20
Lower 3rd Adjacent Interferer	Hybrid	-10
	Hybrid	+5
	Hybrid	+20

Table 5 - AM Analog Compatibility: Objective Testing Matrix

3.5 Subjective test procedure

The following procedure was followed to perform the NRSC Subjective Testing. Execution of this procedure follows that of the Daily Calibration Procedure (Section 3.2) and the Receiver Calibration Procedure (Section 3.3).

Host Compatibility:

1. Remove all attenuation from the undesired exciter's RF signal path, except that of the 1/839 attenuator. Set the attenuation of the 1/839 attenuator to that determined in the Daily Calibration Procedure (Section 3.2).
2. Measure the unmodulated RF signal power being output by the undesired exciter according to the *RF Power Measurement* procedure (Section 3.1.1). If necessary, adjust the attenuation of the appropriate Kay Elemetrics 1/839 attenuator to produce an RF level nearer to –14.00 dBm. If an adjustment is made, record the attenuator switch settings and the resultant RF power level in the Calibration Results template.
3. Reconnect splitter #2 to the BNC bulkhead. Add the appropriate attenuation to the Final RF Adjust attenuator to achieve a moderate RF level for the particular DUT. The RF levels to be used are included in Attachment A.
4. For the analog host compatibility testing, the DAB should be turned "OFF" using the DAB on/off button, and the 5 kHz LPF should be set to "OFF". The analog gain of the undesired exciter should be set to 1.445498.
5. Consult the Subjective Testing Matrix to determine the appropriate audio cuts for Analog Host Compatibility. At this moderate RF level, perform the *Audio Recording* according to the procedure in Section 3.1.6. Save the recording with an intuitive filename.
6. For the hybrid host compatibility testing, the DAB should be turned "ON" using the DAB on/off button, and the 5 kHz LPF should be set to "OFF".
7. Perform the *Audio Recording* according to the procedure in Section 3.1.6. Save the recording with an intuitive filename.

Analog Compatibility in the presence of interferers:

1. Retune the undesired exciter to the interferer frequency, shutdown the exciter, and restart it as described in Sections 3.1.3 and 3.1.4. The exciter should not be shut down in Network mode. Both exciters should be configured for analog gain of 1. 445498and the 5 kHz LPFs turned OFF.
2. Remove all attenuation from the desired exciter's RF signal path, except that of the 1/839 attenuator. Set the attenuation of the 1/839 attenuator to that determined in the Daily Calibration Procedure (Section 3.2).
3. Measure the unmodulated RF signal power being output by the desired exciter according to the *RF Power Measurement* procedure (Section 3.1.1). If necessary, adjust the attenuation of the appropriate Kay Elemetrics 1/839 attenuator to produce an RF level nearer to –14.00 dBm. If an adjustment is made, record the attenuator switch settings and the resultant RF power level in the Calibration Results template.

4. Repeat steps 2 and 3 above for the undesired exciter and RF signal path. Reconnect the outputs of the desired and undesired RF adjust attenuators to the Mini-Circuits ZSC-2-1 combiner/splitter #1.
5. Turn the undesired exciter's DAB carriers on.
6. Add the appropriate attenuation to the Final RF Adjust attenuator to achieve a moderate RF level for the particular DUT. The RF levels to be used are included in Attachment A.
7. For the 3rd adjacent interference scenario, remove 10 dB of attenuation from the final RF adjust attenuator and add 10 dB to the desired RF adjust attenuator to obtain a –10 dB D/U ratio.
8. Consult the Subjective Testing Matrix to determine the appropriate desired audio cuts for this hybrid interferer and D/U ratio. At this moderate RF level, perform the *Audio Recording* according to the procedure in Section 3.1.6.
9. Add 7.5 dB of attenuation to the undesired RF adjust attenuator and Repeat step 8.
10. Add 7.5 dB of additional attenuation to the undesired RF adjust attenuator and repeat step 8.
11. Add 7.5 dB of additional attenuation to the undesired RF adjust attenuator and repeat step 8.
12. Add 7.5 dB of additional attenuation to the undesired RF adjust attenuator and repeat step 8.
13. Remove 30 dB of attenuation from the undesired RF adjust attenuator. Turn the undesired exciter's DAB carriers off.
14. Consult the Subjective Testing Matrix to determine the appropriate desired audio cuts for this analog interferer and D/U ratio. At this moderate RF level, perform the *Audio Recording* according to the procedure in Section 3.1.6.
15. Add 7.5 dB of attenuation to the undesired RF adjust attenuator and Repeat step 14.
16. Add 7.5 dB of additional attenuation to the undesired RF adjust attenuator and repeat step 14.
17. Add 7.5 dB of additional attenuation to the undesired RF adjust attenuator and repeat step 14.
18. Add 7.5 dB of additional attenuation to the undesired RF adjust attenuator and repeat step 14.
19. Repeat steps 1-18 for each of the interferers shown in the table below.

Test Scenario			Audio Cuts			
Scenario	Interferer Type	D/U, dB	Classical	Rock	Voiceover	Speech
Analog Host	N/A	N/A	Carmen	Santana	From Richmond	MaleC5
Hybrid Host	N/A	N/A	Carmen	Santana	From Richmond	MaleC5
Upper 1st Adjacent Interferer	Analog	0	Bach	Clapton	Ballet Woman	FemaleA1
	Analog	+7.5	Ibert	Cole	RiverDance	Male A1
	Analog	+15	Debussy	EarthWindFire	Camera	FemaleB2
	Analog	+22.5	Messiah	Fleetwood	Imagine	MaleB4
	Analog	+30	Stravinsky	Vega	WTOP theme	Female C10
Upper 1st Adjacent Interferer	Hybrid	0	Bach	Clapton	Ballet Woman	FemaleA1
	Hybrid	+7.5	Ibert	Cole	RiverDance	Male A1
	Hybrid	+15	Debussy	EarthWindFire	Camera	FemaleB2
	Hybrid	+22.5	Messiah	Fleetwood	Imagine	MaleB4
	Hybrid	+30	Stravinsky	Vega	WTOP theme	Female C10
Lower 1st Adjacent Interferer	Analog	0	Bach	Clapton	Ballet Woman	FemaleA1
	Analog	+7.5	Ibert	Cole	RiverDance	Male A1
	Analog	+15	Debussy	EarthWindFire	Camera	FemaleB2
	Analog	+22.5	Messiah	Fleetwood	Imagine	MaleB4
	Analog	+30	Stravinsky	Vega	WTOP theme	Female C10
Lower 1st Adjacent Interferer	Hybrid	0	Bach	Clapton	Ballet Woman	FemaleA1
	Hybrid	+7.5	Ibert	Cole	RiverDance	Male A1
	Hybrid	+15	Debussy	EarthWindFire	Camera	FemaleB2
	Hybrid	+22.5	Messiah	Fleetwood	Imagine	MaleB4
	Hybrid	+30	Stravinsky	Vega	WTOP theme	Female C10
Upper 2nd Adjacent Interferer	Analog	0	Bach	Fagen	Ballet Woman	FemaleA1
	Analog	+7.5	Ibert	Grant	RiverDance	Male A1
	Analog	+15	Debussy	REO	Camera	FemaleB2
	Analog	+22.5	Messiah	Stansfield	Imagine	MaleB4
	Analog	+30	Stravinsky	Travis	WTOP theme	Female C10
Upper 2nd Adjacent Interferer	Hybrid	0	Bach	Fagen	Ballet Woman	FemaleA1
	Hybrid	+7.5	Ibert	Grant	RiverDance	Male A1
	Hybrid	+15	Debussy	REO	Camera	FemaleB2
	Hybrid	+22.5	Messiah	Stansfield	Imagine	MaleB4
	Hybrid	+30	Stravinsky	Travis	WTOP theme	Female C10
Lower 2nd Adjacent Interferer	Analog	0	Bach	Fagen	Ballet Woman	FemaleA1
	Analog	+7.5	Ibert	Grant	RiverDance	Male A1
	Analog	+15	Debussy	REO	Camera	FemaleB2
	Analog	+22.5	Messiah	Stansfield	Imagine	MaleB4
	Analog	+30	Stravinsky	Travis	WTOP theme	Female C10
Lower 2nd Adjacent Interferer	Hybrid	0	Bach	Fagen	Ballet Woman	FemaleA1
	Hybrid	+7.5	Ibert	Grant	RiverDance	Male A1
	Hybrid	+15	Debussy	REO	Camera	FemaleB2
	Hybrid	+22.5	Messiah	Stansfield	Imagine	MaleB4
	Hybrid	+30	Stravinsky	Travis	WTOP theme	Female C10

Table 6 - AM Analog Compatibility: Subjective Testing Matrix

4. Summary of Results

4.1 Objective Test Results

The objective testing was performed on August 13th and 14th, 2001. Tom Keller of the NRSC was present as an independent observer during all calibration and testing on these dates. As mentioned in the procedures, all objective testing audio measurements were performed with the Audio Precision System II Cascade.

The following tables summarize the SNR measurements taken during this testing. Calibration results from these test dates are included in Attachment B.

4.1.1 Pioneer KEH-1900

Test Scenario			Weighted Quasi-peak SNR (dB)
Scenario	Interferer Type	D/U, dB	
Analog Host	N/A	N/A	45.5
Hybrid Host	N/A	N/A	39.8
Upper 1st Adjacent Interferer	Analog	+0	14.3
	Analog	+15	28.8
	Analog	+30	41.5
Upper 1st Adjacent Interferer	Hybrid	+0	12.6
	Hybrid	+15	26.9
	Hybrid	+30	40.5
Lower 1st Adjacent Interferer	Analog	+0	13.3
	Analog	+15	27.8
	Analog	+30	40.9
Lower 1st Adjacent Interferer	Hybrid	+0	13.5
	Hybrid	+15	27.8
	Hybrid	+30	41.2
Upper 2nd Adjacent Interferer	Analog	+0	45.5
	Analog	+15	45.6
	Analog	+30	45.5
Upper 2nd Adjacent Interferer	Hybrid	+0	43.3
	Hybrid	+15	45.5
	Hybrid	+30	45.6
Lower 2nd Adjacent Interferer	Analog	+0	45.5
	Analog	+15	45.5
	Analog	+30	45.5
Lower 2nd Adjacent Interferer	Hybrid	+0	38.2
	Hybrid	+15	45.1
	Hybrid	+30	45.5
Upper 3rd Adjacent Interferer	Analog	-10	45.5
	Analog	+5	45.5
	Analog	+20	45.5
Upper 3rd Adjacent Interferer	Hybrid	-10	45.4
	Hybrid	+5	45.5
	Hybrid	+20	45.5
Lower 3rd Adjacent Interferer	Analog	-10	45.4
	Analog	+5	45.5
	Analog	+20	45.5
Lower 3rd Adjacent Interferer	Hybrid	-10	45.5
	Hybrid	+5	45.5
	Hybrid	+20	45.5

Table 7 - Objective Test Results: Pioneer

4.1.2 Technics SA-EX110

Test Scenario			Weighted Quasi-peak SNR (dB)
Scenario	Interferer Type	D/U, dB	
Analog Host	N/A	N/A	47.5
Hybrid Host	N/A	N/A	38.5
Upper 1st Adjacent Interferer	Analog	+0	15.4
	Analog	+15	30.1
	Analog	+30	43.1
Upper 1st Adjacent Interferer	Hybrid	+0	11.8
	Hybrid	+15	26.4
	Hybrid	+30	40.5
Lower 1st Adjacent Interferer	Analog	+0	12.6
	Analog	+15	27.0
	Analog	+30	40.9
Lower 1st Adjacent Interferer	Hybrid	+0	14.5
	Hybrid	+15	29.2
	Hybrid	+30	42.6
Upper 2nd Adjacent Interferer	Analog	+0	47.4
	Analog	+15	47.5
	Analog	+30	47.5
Upper 2nd Adjacent Interferer	Hybrid	+0	37.9
	Hybrid	+15	46.5
	Hybrid	+30	47.5
Lower 2nd Adjacent Interferer	Analog	+0	47.4
	Analog	+15	47.6
	Analog	+30	47.5
Lower 2nd Adjacent Interferer	Hybrid	+0	32.5
	Hybrid	+15	44.5
	Hybrid	+30	47.4
Upper 3rd Adjacent Interferer	Analog	-10	44.7
	Analog	+5	47.5
	Analog	+20	47.5
Upper 3rd Adjacent Interferer	Hybrid	-10	43.9
	Hybrid	+5	47.5
	Hybrid	+20	47.5
Lower 3rd Adjacent Interferer	Analog	-10	43.4
	Analog	+5	47.5
	Analog	+20	47.5
Lower 3rd Adjacent Interferer	Hybrid	-10	42.3
	Hybrid	+5	47.5
	Hybrid	+20	47.5

Table 8 - Objective Test Results: Technics

4.1.3 Delphi 9394139

Test Scenario			Weighted Quasi-peak SNR (dB)
Scenario	Interferer Type	D/U, dB	
Analog Host	N/A	N/A	45.1
Hybrid Host	N/A	N/A	44.3
Upper 1st Adjacent Interferer	Analog	+0	14.9
	Analog	+15	29.5
	Analog	+30	41.8
Upper 1st Adjacent Interferer	Hybrid	+0	13.9
	Hybrid	+15	28.4
	Hybrid	+30	41.3
Lower 1st Adjacent Interferer	Analog	+0	14.6
	Analog	+15	29.2
	Analog	+30	41.6
Lower 1st Adjacent Interferer	Hybrid	+0	14.2
	Hybrid	+15	28.7
	Hybrid	+30	41.5
Upper 2nd Adjacent Interferer	Analog	+0	45.1
	Analog	+15	45.1
	Analog	+30	45.1
Upper 2nd Adjacent Interferer	Hybrid	+0	43.6
	Hybrid	+15	45.1
	Hybrid	+30	45.1
Lower 2nd Adjacent Interferer	Analog	+0	45.1
	Analog	+15	45.1
	Analog	+30	45.1
Lower 2nd Adjacent Interferer	Hybrid	+0	43.8
	Hybrid	+15	45.0
	Hybrid	+30	45.1
Upper 3rd Adjacent Interferer	Analog	-10	45.1
	Analog	+5	45.1
	Analog	+20	45.1
Upper 3rd Adjacent Interferer	Hybrid	-10	45.0
	Hybrid	+5	45.1
	Hybrid	+20	45.1
Lower 3rd Adjacent Interferer	Analog	-10	45.1
	Analog	+5	45.1
	Analog	+20	45.1
Lower 3rd Adjacent Interferer	Hybrid	-10	45.1
	Hybrid	+5	45.1
	Hybrid	+20	45.1

Table 9 - Objective Test Results: Delphi

4.1.4 Sony CFD-S22

Test Scenario			Weighted Quasi-peak SNR (dB)
Scenario	Interferer Type	D/U, dB	
Analog Host	N/A	N/A	40.8
Hybrid Host	N/A	N/A	33.7
Upper 1st Adjacent Interferer	Analog	+0	15.5
	Analog	+15	29.7
	Analog	+30	39.4
Upper 1st Adjacent Interferer	Hybrid	+0	11.5
	Hybrid	+15	25.7
	Hybrid	+30	37.8
Lower 1st Adjacent Interferer	Analog	+0	11.5
	Analog	+15	25.5
	Analog	+30	37.6
Lower 1st Adjacent Interferer	Hybrid	+0	12.8
	Hybrid	+15	27.0
	Hybrid	+30	38.5
Upper 2nd Adjacent Interferer	Analog	+0	40.6
	Analog	+15	40.8
	Analog	+30	40.8
Upper 2nd Adjacent Interferer	Hybrid	+0	29.6
	Hybrid	+15	39.4
	Hybrid	+30	40.7
Lower 2nd Adjacent Interferer	Analog	+0	39.6
	Analog	+15	40.8
	Analog	+30	40.8
Lower 2nd Adjacent Interferer	Hybrid	-2	20.0
	Hybrid	+0	Not measurable[1]
	Hybrid	+2	23.8
	Hybrid	+15	35.4
	Hybrid	+30	40.5
Upper 3rd Adjacent Interferer	Analog	-10	40.8
	Analog	+5	40.7
	Analog	+20	40.8
Upper 3rd Adjacent Interferer	Hybrid	-10	40.8
	Hybrid	+5	40.7
	Hybrid	+20	40.8
Lower 3rd Adjacent Interferer	Analog	-10	40.8
	Analog	+5	40.8
	Analog	+20	40.7
Lower 3rd Adjacent Interferer	Hybrid	-10	40.7
	Hybrid	+5	40.8
	Hybrid	+20	40.8

Table 10 - Objective Test Results: Sony

[1] The System II was not able to measure the SNR with this interferer scenario. The SNR's at +2 dB and -2 dB D/U levels were measured for this interference scenario, instead.

4.2 Subjective Test Results

The bulk of the subjective testing was performed September 20th and 21st, 2001. Bob Mallery of Denny and Associates was present as an independent observer during all calibration and testing on these dates.

During an examination of the subjective audio samples, Xetron and iBiquity found that some of the samples contained minor distortions, manifest as low-level, but audible "clicks." The source of this distortion was determined to be the direct-to-disk audio recording system, comprised of the testbed PC and Cool Edit Pro software. All tests corresponding to the affected samples were re-run on October 10th, 11th and 31st. By agreement with the NRSC, both original and re-test subjective audio recordings were preserved and archived by Xetron.

As mentioned in the test procedures, all audio measurements were performed with the HP Audio Analyzer. Calibration results from all these test dates are included in Attachment B.

Digital copies of the subjective test recordings were forwarded to iBiquity Digital for use in subjective evaluation at Dynastat.

5. Attachments

Attachment A: Determination of Signal Levels

The appropriate signal levels for the NRSC testing were determined by the following procedure:

1. The voltage developed at the input of each receiver was measured at a location near Xetron's 10 kW AM station, but out of the nearfield. The antenna connected to each receiver was either the OEM antenna, in the case of the Sony and Technics receiver, or a 31" unfiltered whip antenna with about 80 pF of capacitance, for the automotive units. The directional antennas in the Sony and Technics receivers were oriented such that a maximum signal level was attained. The voltage was measured with a high-impedence probe and an oscilloscope, so that the measurement itself did not effect the voltage present at the receiver's input terminals.
2. The RF Field Intensity (FI) was measured at the same location using a Field Intensity Meter (FIM).
3. Because the voltage developed by any antenna falls off linearly with field strength, the voltage at the receivers' inputs was predicted for FI's of 25 mV/m (strong), 5 mV/m (moderate), and 1 mV/m (weak).
4. With a -7 dBm signal (as measured into 50 Ω) at its matching network, the signal level at each receiver's input was measured in the laboratory using the antenna matches and signal sources to be used in the NRSC tests.
5. The level of signal (into 50 Ω) necessary to develop the predicted voltages (from step three) were determined. These are the recommended levels listed below.

Comments:
Step 1: Even at a very strong signal level (197 mV/m), interfering signals complicate measurement of the level of desired signal when the carrier is unmodulated. To remedy this problem, we modulated the desired signal with a ±100% 1 kHz tone, and measured the level of the modulation (i.e. the levels of the positive and negative peaks and troughs). The level of an unmodulated carrier at the same measurement point was approximated as the average of these values:

$$V_{PP,\mathrm{un\,mod\,ulated}} \approx \frac{(V_{+PEAK} - V_{+TROUGH}) + (V_{-TROUGH} - V_{-PEAK})}{2}$$

Step 2: The absolute FI was measured to be 197 mV/m at our particular location. This was measured with a standard FIM.

Step 3: The voltages at strong, moderate, and weak levels would be 18, 32, and 46 dB below the levels measured at this location, respectively.

Step 4: Because this step was executed in the laboratory screen cage, we were able to directly measure the peak-to-peak voltage of the unmodulated carrier at the receivers' inputs.

Step 5: The recommended moderate levels are as shown in the table below. -62 dBm was recommended for the automotive receivers due to its use in previous testing, and by suggestion of Tom Keller. Strong and weak RF testing should be conducted at 14 dB higher levels and 14 dB lower levels than those in the table, respectively.

Receiver	Recommended Moderate RF Level
Delphi 9394139	-62 dBm
Pioneer KEH-1900	-62 dBm
Technics SA-EX110	-69 dBm
Sony CFD-S22	-76 dBm

Table 11 - Recommended RF Levels

Attachment B: Daily Calibration Results

NRSC AM Band Analog Compatibility Tests - Calibration Results

Tested By : NB,DH,DR,BM NRSC Observer: Tom K.
Date Tested : 8/13/01

RF Signal Power Levels: The exciters will be set to a 1.0 MHz transmit frequency.

	Unmodulated Analog Carrier		
iDAB Exciter	**Initial RF Signal Power Level (dBm)**	**Attenuation Added (dB)**	**New RF Signal Power Level (dBm)**
DEV 23 - Desired	-13.15	0.90	-13.96
DEV 62 - Undesired	-13.03	1.00	-14.01

	DAB Carriers			
iDAB Exciter	**Core Power Level (dBm)**	**Outer Enhanced Power Level (dBm)**	**Inner Enhanced Power Level (dBm)**	**Unmodulated Carrier Power**
DEV 62 - Undesired	-23.1	-36.9	-41.1	-6.9

RF Spectrum: The exciters will be set to a 1.0 MHz transmit frequency.

iDAB Exciter	Unmodulated Analog Carrier Plot #	DAB On Plot #
DEV 23 - Desired	2	3
DEV 62 - Undesired	0	1

Modulation Levels: The exciters will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

iDAB Exciter	Modulation Level with Full-Scale 1 kHz Tone (%)	Modulation Level with 4.5kHz Processed Pink Noise (%)
DEV 23 - Desired	-100 +101	
DEV 62 - Undesired	-100 + 100	-100 +124

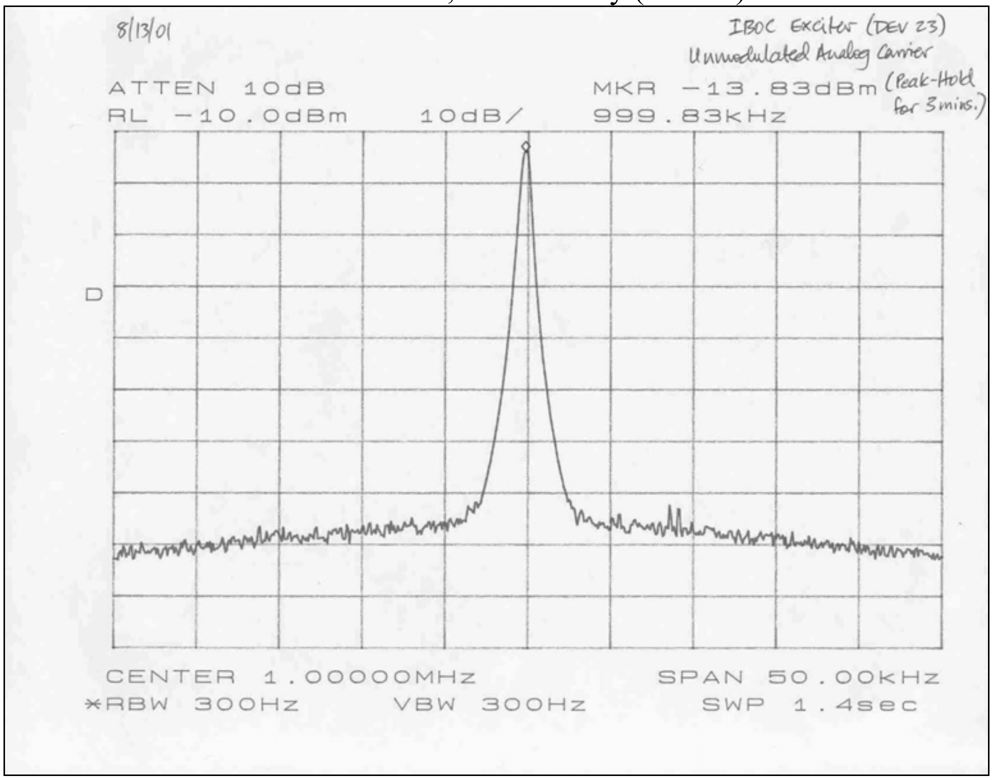
Audio Output Power Level & Distortion Level: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	Audio Output Power Level (Watts)	Distortion Level (%) at 100% modulation	Distortion Level (%) at 80% modulation
Delphi 9394139	-48 (Strong)	0.67	0.74	0.26
	-62 (Moderate)	0.66	0.73	0.32
Pioneer KEH-1900	-48 (Strong)	0.81	0.83	Not Measured
	-62 (Moderate)	0.69	0.98	Not Measured
Technics SA-EX110	-55 (Strong)	10.4E-6	2.10	1.15
	-69 (Moderate)	7.3E-6	2.66	1.31
Sony CFD-S22	-62 (Strong)			
	-76 (Moderate)			

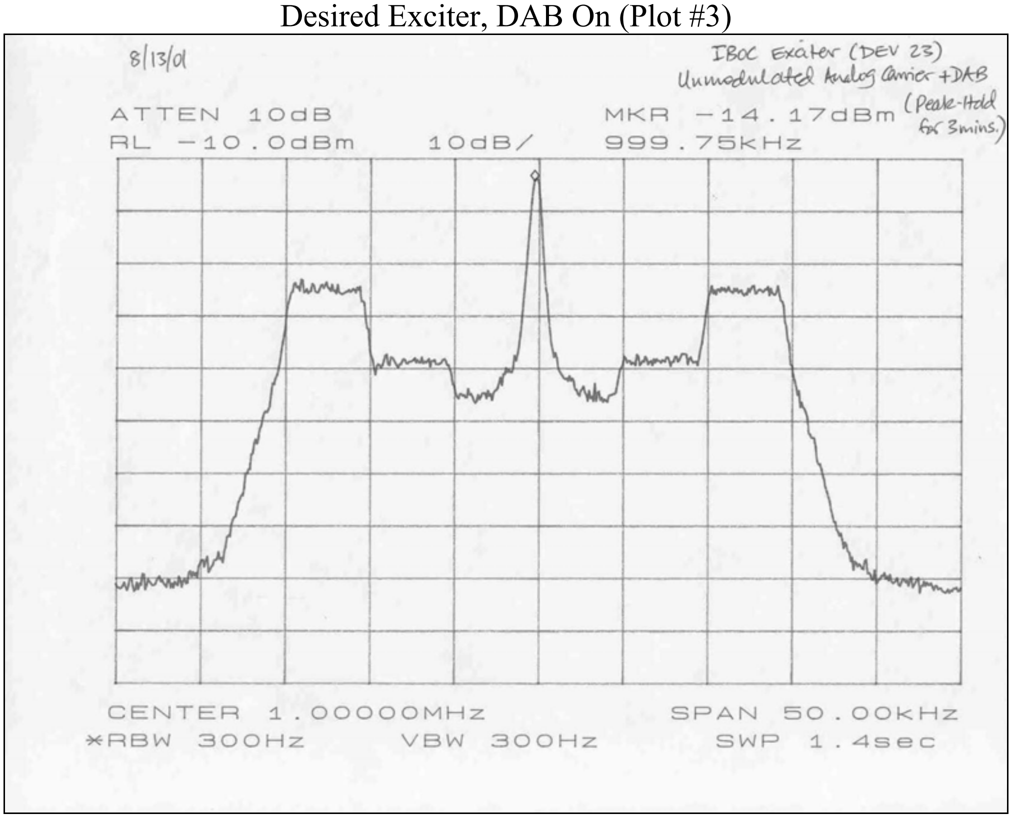
Analog SNR Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	56.9
	-62 (Moderate)	45.2
	-76 (Weak)	31.9
Pioneer KEH-1900	-48 (Strong)	58.3
	-62 (Moderate)	45.5
	-76 (Weak)	31.5
Technics SA-EX110	-55 (Strong)	54.2
	-69 (Moderate)	47.5
	-83 (Weak)	34.7
Sony CFD-S22	-62 (Strong)	
	-76 (Moderate)	
	-90 (Weak)	

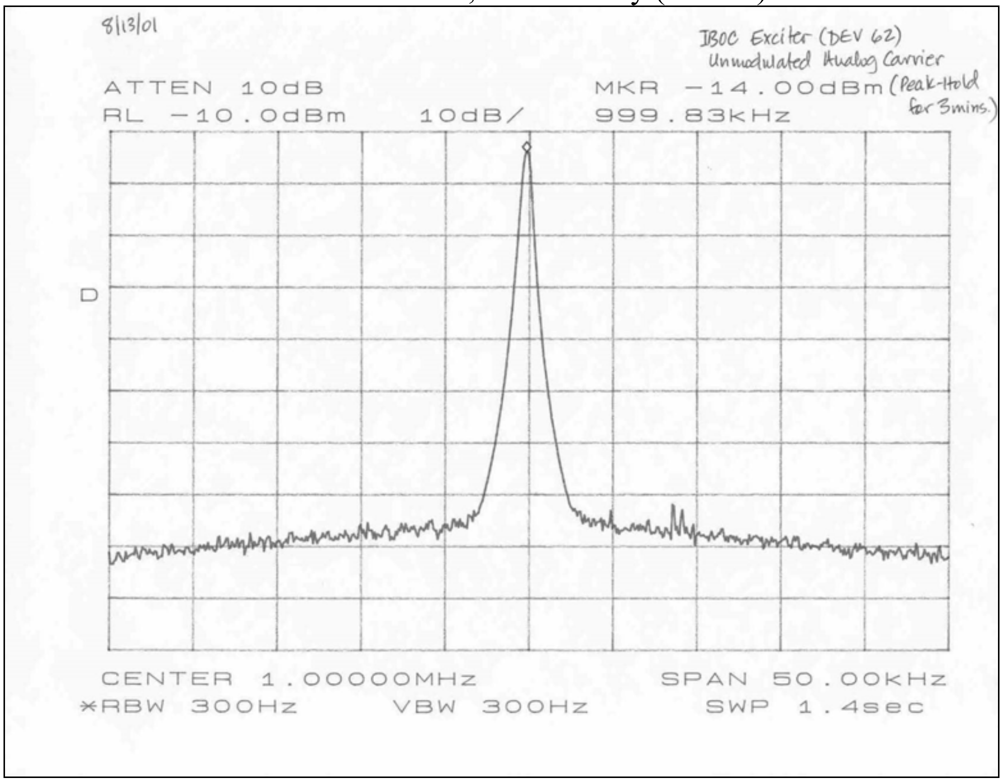
Desired Exciter, Carrier Only (Plot #2)



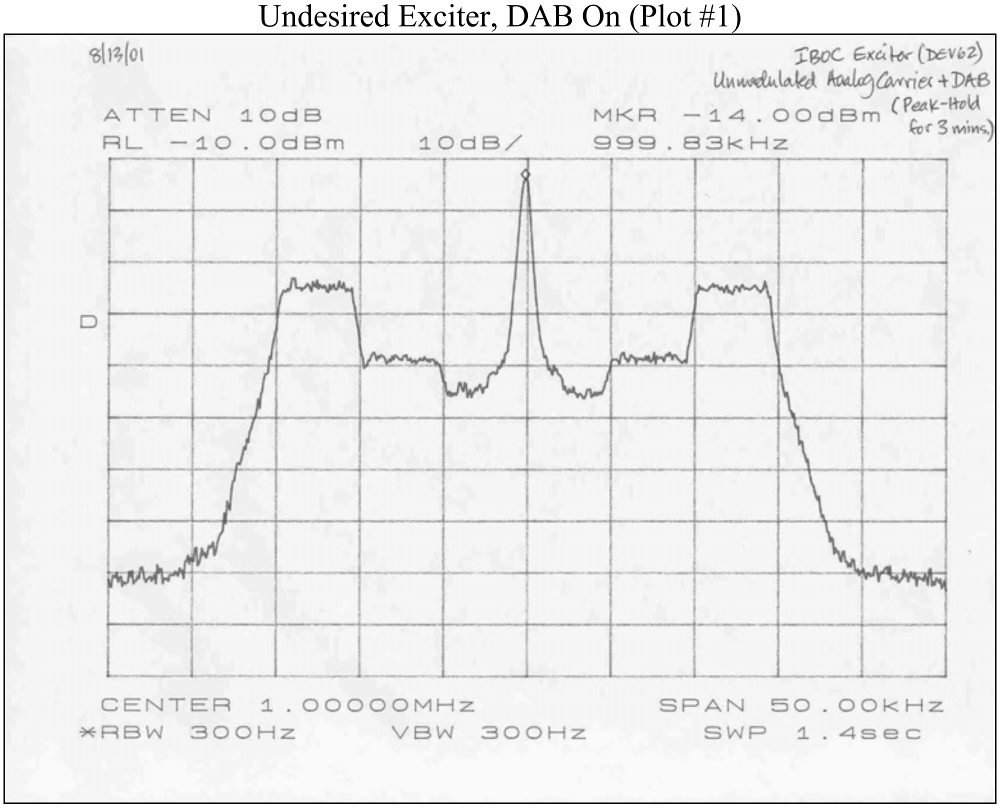
Desired Exciter, DAB On (Plot #3)



Undesired Exciter, Carrier Only (Plot #0)



Undesired Exciter, DAB On (Plot #1)



NRSC AM Band Analog Compatibility Tests - Calibration Results

Tested By : NB,DH,DR,BM NRSC Observer: Tom K.
Date Tested : 8/14/01

RF Signal Power Levels: The exciters will be set to a 1.0 MHz transmit frequency.

	Unmodulated Analog Carrier		
iDAB Exciter	**Initial RF Signal Power Level (dBm)**	**Attenuation Added (dB)**	**New RF Signal Power Level (dBm)**
DEV 23 - Desired	-13.16	0.90	-13.98
DEV 62 - Undesired	-13.03	1.00	-14.02

	DAB Carriers			
iDAB Exciter	**Core Power Level (dBm)**	**Outer Enhanced Power Level (dBm)**	**Inner Enhanced Power Level (dBm)**	**Unmodulated Carrier Power**
DEV 62 - Undesired	-23.2	-36.9	-41.0	-6.9

RF Spectrum: The exciters will be set to a 1.0 MHz transmit frequency.

iDAB Exciter	Unmodulated Analog Carrier Plot #	DAB On Plot #
DEV 23 - Desired	6	7
DEV 62 - Undesired	4	5

Modulation Levels: The exciters will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

iDAB Exciter	Modulation Level with Full-Scale 1 kHz Tone (%)	Modulation Level with 4.5kHz Processed Pink Noise (%)
DEV 23 - Desired	-99 +101	-100 +124
DEV 62 - Undesired	-100 +101	-100 +124

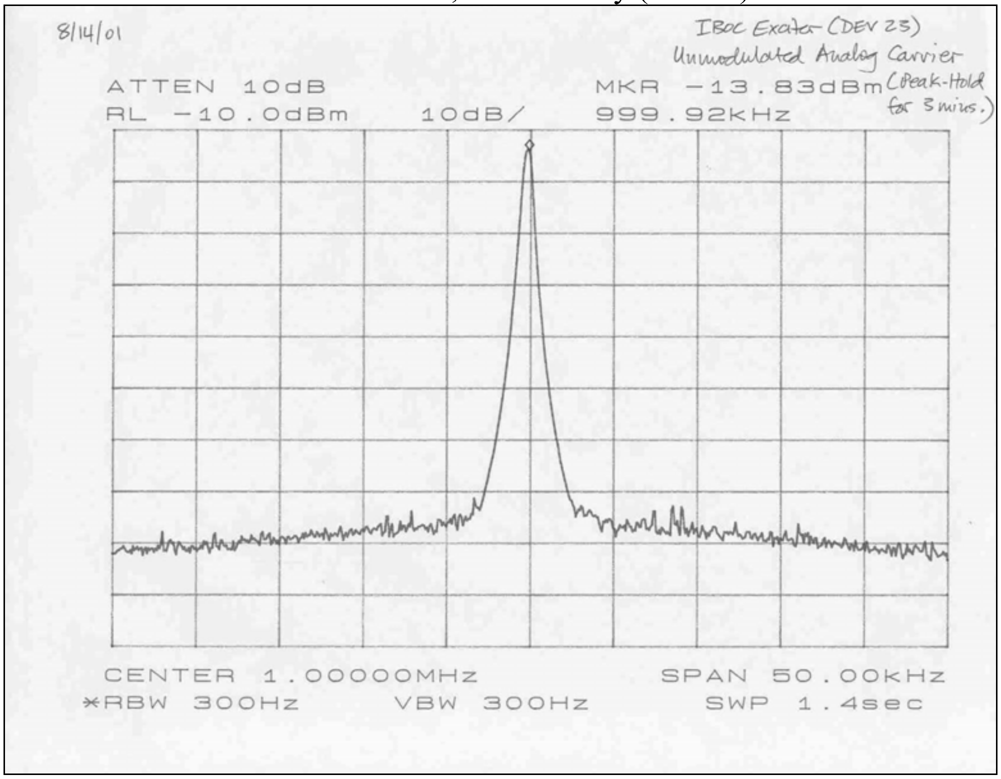
Audio Output Power Level & Distortion Level: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	Audio Output Power Level (Watts)	Distortion Level (%) at 100% modulation	Distortion Level (%) at 80% modulation
Delphi 9394139	-48 (Strong)			
	-62 (Moderate)			
Pioneer KEH-1900	-48 (Strong)	0.81	0.81	0.16
	-62 (Moderate)	0.69	0.94	0.31
Technics SA-EX110	-55 (Strong)			
	-69 (Moderate)			
Sony CFD-S22	-62 (Strong)	0.21	1.90	0.65
	-76 (Moderate)	0.19	2.27	0.93

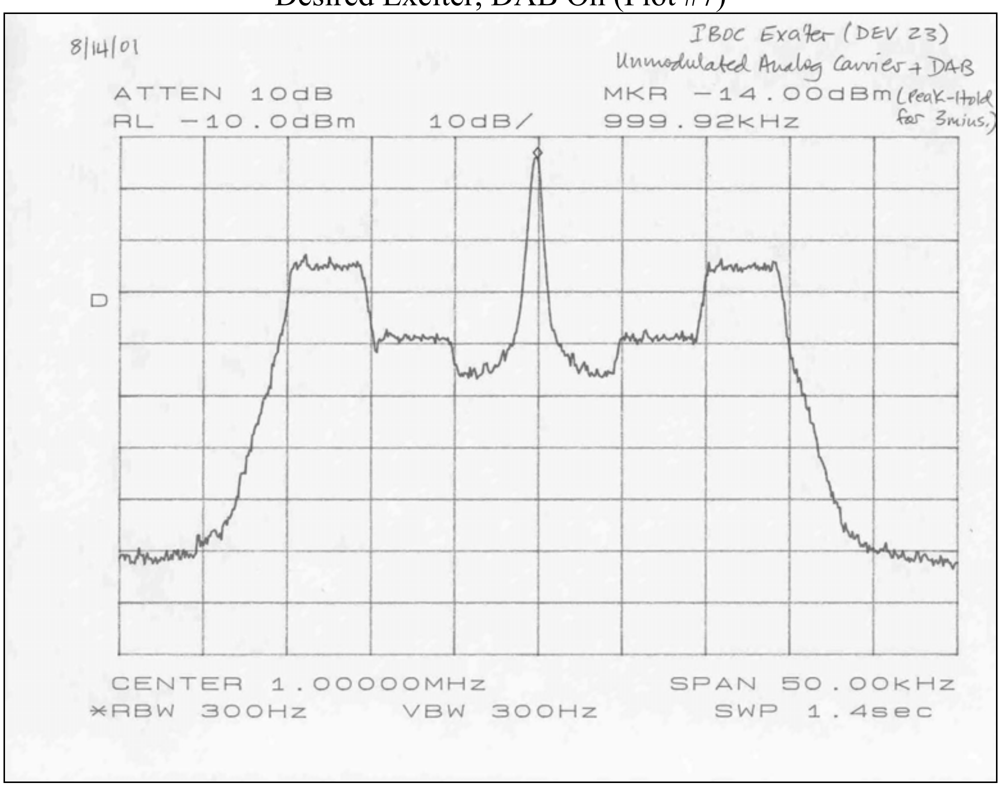
Analog SNR Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	
	-62 (Moderate)	
	-76 (Weak)	
Pioneer KEH-1900	-48 (Strong)	58.3
	-62 (Moderate)	45.5
	-76 (Weak)	31.5
Technics SA-EX110	-55 (Strong)	
	-69 (Moderate)	
	-83 (Weak)	
Sony CFD-S22	-62 (Strong)	49.3
	-76 (Moderate)	40.8
	-90 (Weak)	29.4

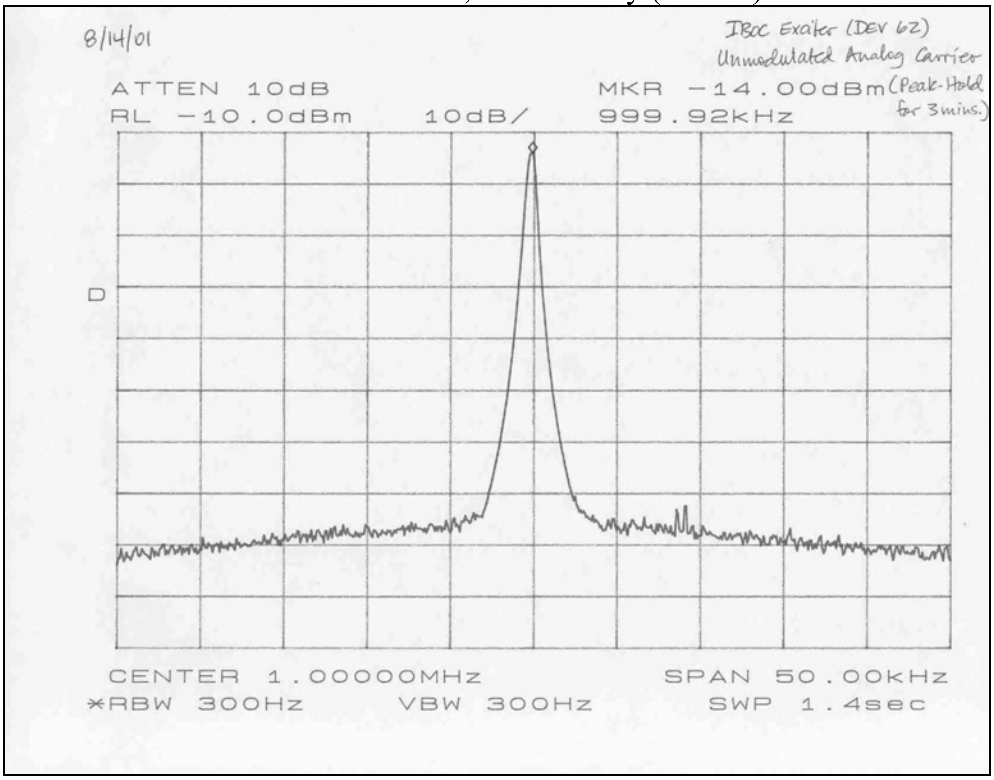
Desired Exciter, Carrier Only (Plot #6)



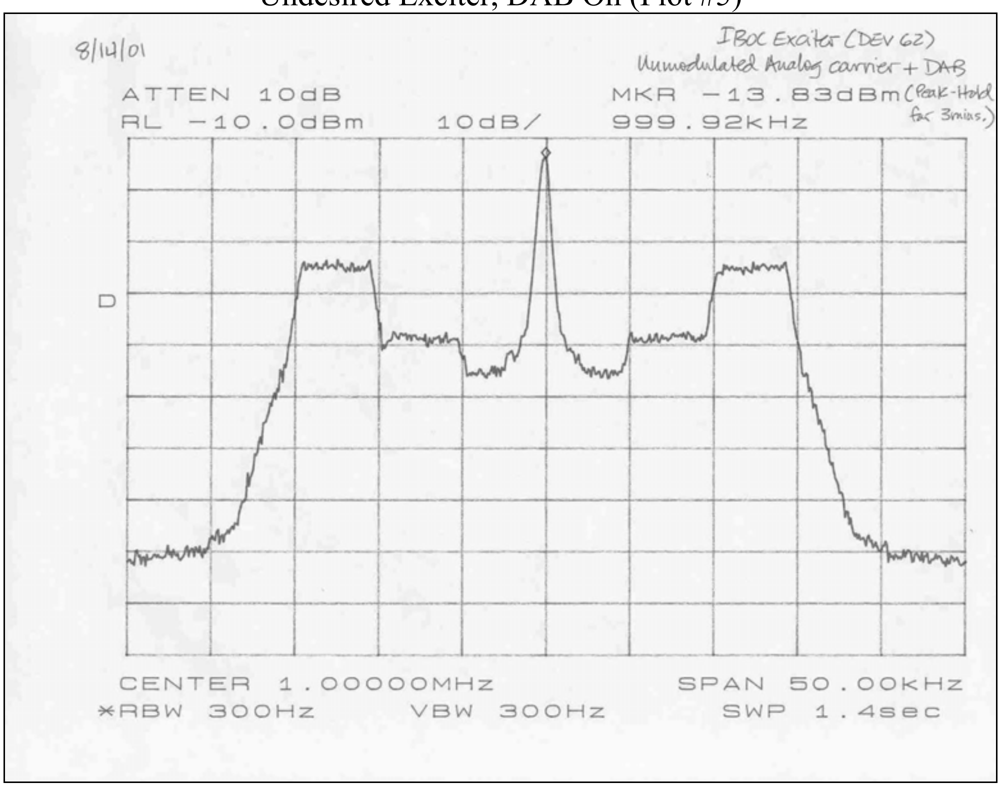
Desired Exciter, DAB On (Plot #7)



Undesired Exciter, Carrier Only (Plot #4)



Undesired Exciter, DAB On (Plot #5)



NRSC AM Band Analog Compatibility Tests - Calibration Results

Tested By : DR, BM   NRSC Observer: Bob M.
Date Tested : 9/20/01

RF Signal Power Levels: The exciters will be set to a 1.0 MHz transmit frequency.

	Unmodulated Analog Carrier		
iDAB Exciter	**Initial RF Signal Power Level (dBm)**	**Attenuation Added (dB)**	**New RF Signal Power Level (dBm)**
DEV 23 - Desired	-13.16	0.90	-13.98
DEV 62 - Undesired	-13.07	1.00	-13.96

	DAB Carriers			
iDAB Exciter	**Core Power Level (dBm)**	**Outer Enhanced Power Level (dBm)**	**Inner Enhanced Power Level (dBm)**	**Unmodulated Carrier Power**
DEV 62 - Undesired	-23.1	-37.2	-41.0	-6.9

RF Spectrum: The exciters will be set to a 1.0 MHz transmit frequency.

iDAB Exciter	**Unmodulated Analog Carrier Plot #**	**DAB On Plot #**
DEV 23 - Desired	3	4
DEV 62 - Undesired	1	2

Modulation Levels: The exciters will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

iDAB Exciter	**Modulation Level with Full-Scale 1 kHz Tone (%)**	**Modulation Level with Processed Audio Cuts (%)**
DEV 23 - Desired	-100 / +101	-100 / +123
DEV 62 - Undesired	-100 / +101	-99 / +123

Audio Output Power Level & Distortion Level: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	**RF Level (dBm)**	**Audio Output Power Level (Watts)**	**Distortion Level (%) at 100% modulation**	**Distortion Level (%) at 80% modulation**
Delphi 9394139	-48 (Strong)	0.69	0.84	0.27
	-62 (Moderate)	0.67	0.79	0.35
Pioneer KEH-1900	-48 (Strong)			
	-62 (Moderate)			
Technics SA-EX110	-55 (Strong)	26.2E-3	2.17	1.16
	-69 (Moderate)	18.6E-3	2.72	1.36
Sony CFD-S22	-62 (Strong)			
	-76 (Moderate)			

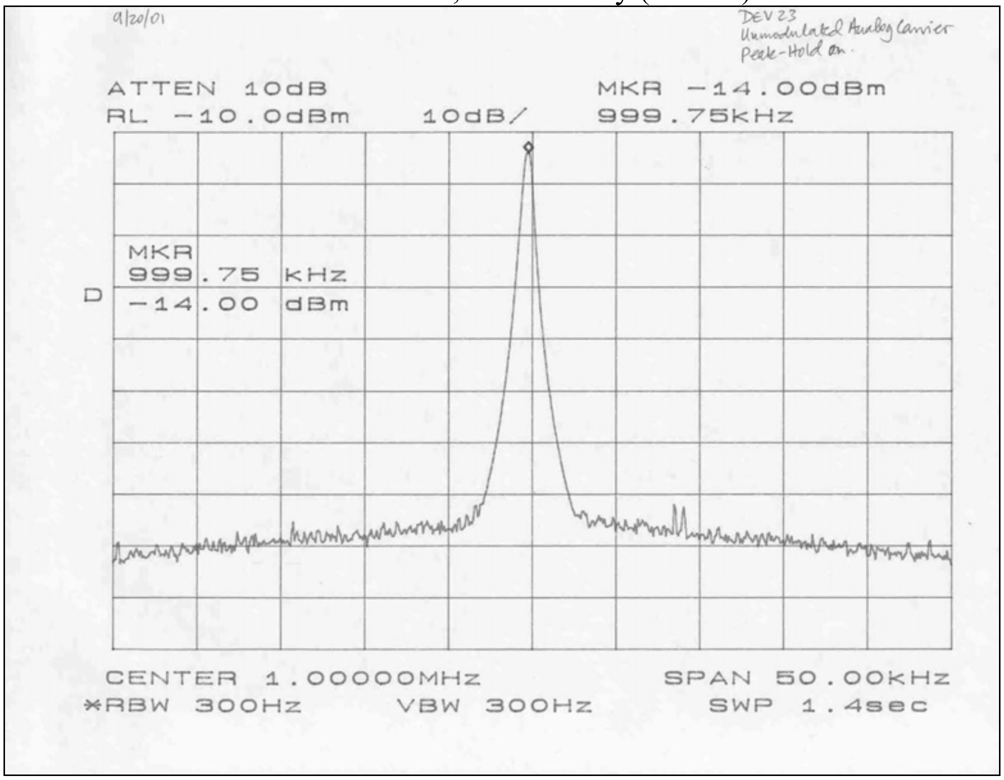
Analog SNR Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	**RF Level (dBm)**	**SNR (dB)**
Delphi 9394139	-48 (Strong)	56.5
	-62 (Moderate)	44.8
	-76 (Weak)	31.5
Pioneer KEH-1900	-48 (Strong)	
	-62 (Moderate)	
	-76 (Weak)	
Technics SA-EX110	-55 (Strong)	52.2
	-69 (Moderate)	41.6
	-83 (Weak)	28.0
Sony CFD-S22	-62 (Strong)	
	-76 (Moderate)	
	-90 (Weak)	

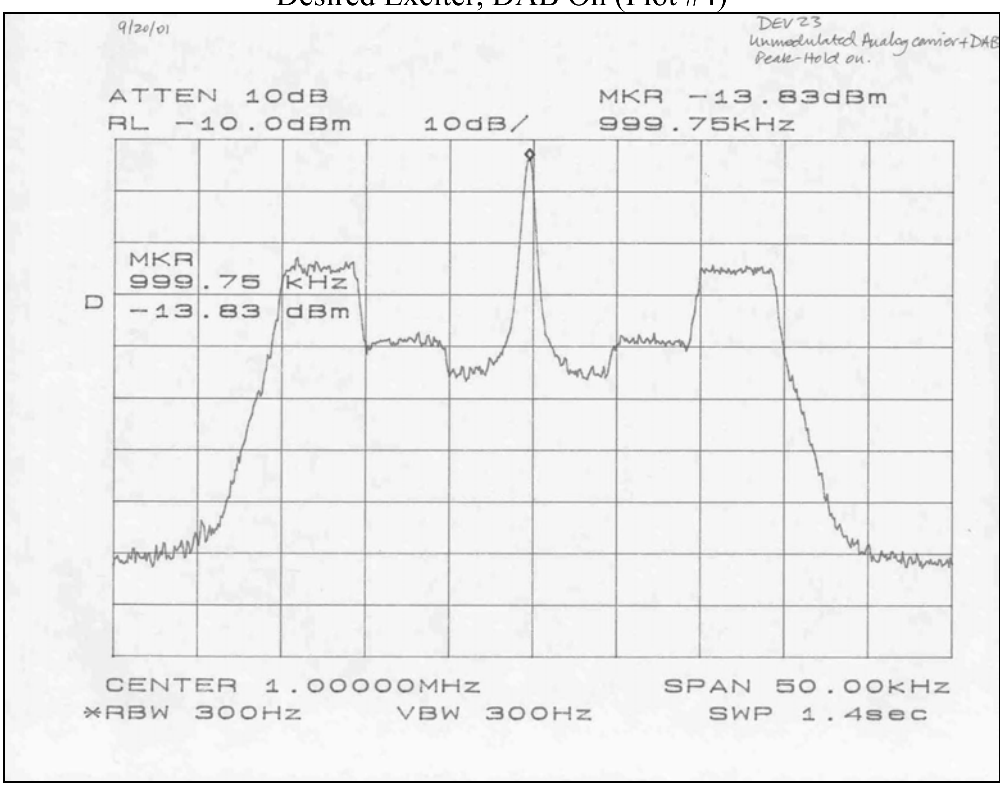
Recording Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	**RF Level (dBm)**	**SNR (dB)**
Delphi 9394139	-48 (Strong)	56.5
Pioneer KEH-1900	-48 (Strong)	
Technics SA-EX110	-55 (Strong)	52.2
Sony CFD-S22	-62 (Strong)	

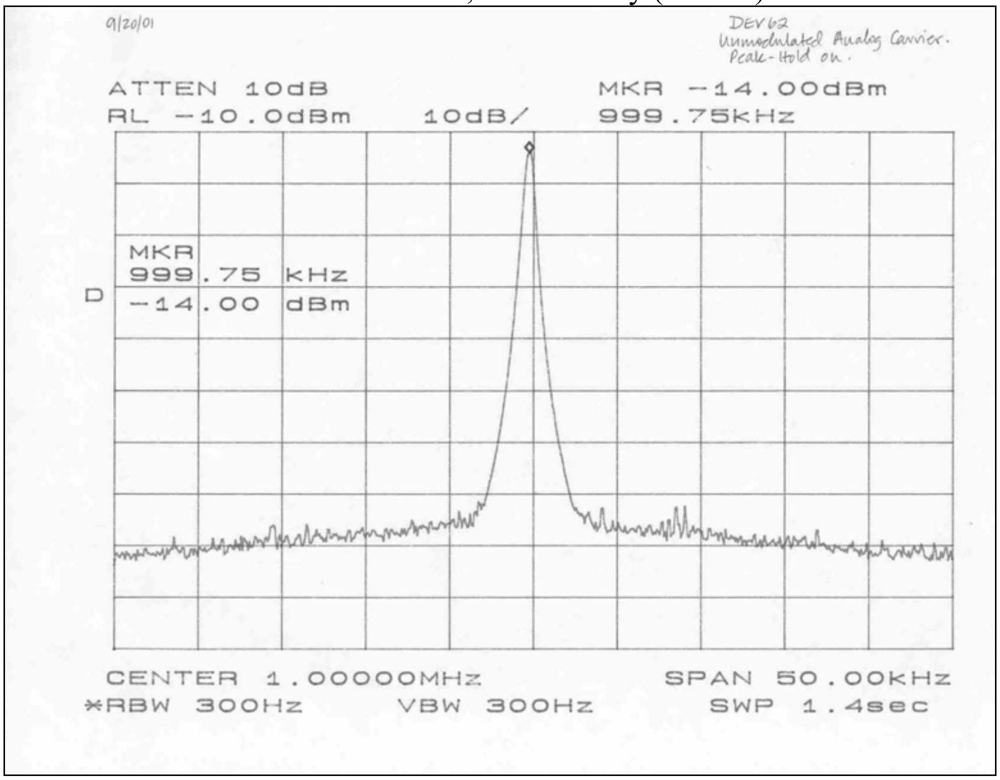
Desired Exciter, Carrier Only (Plot #3)



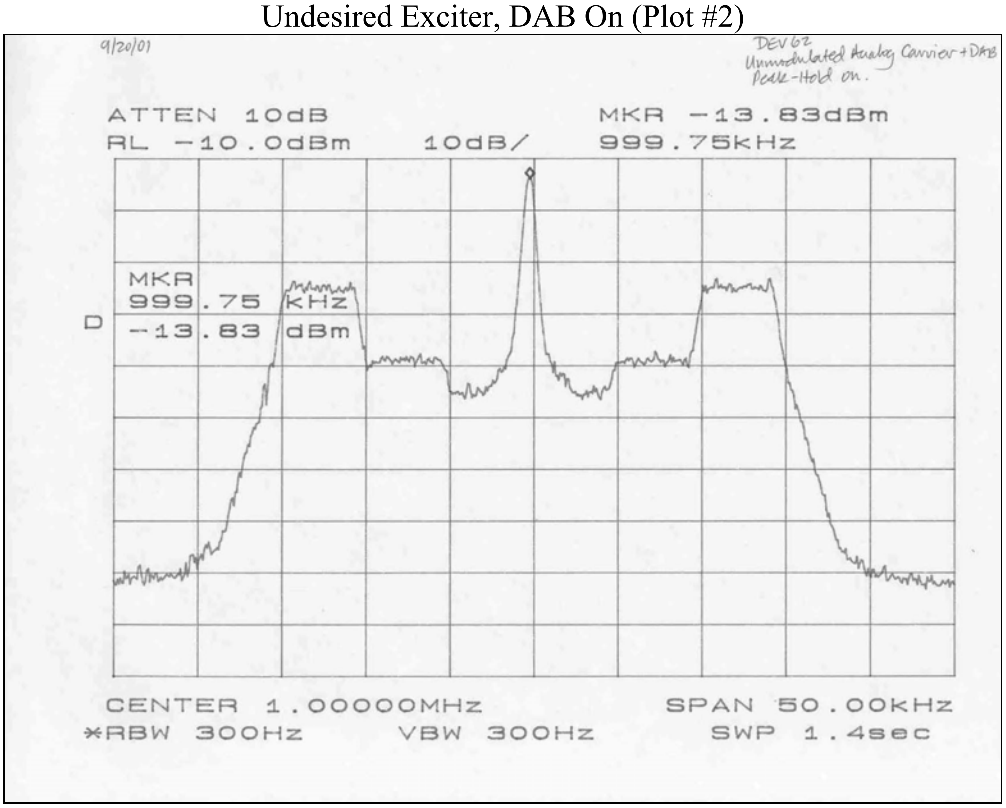
Desired Exciter, DAB On (Plot #4)



Undesired Exciter, Carrier Only (Plot #1)



Undesired Exciter, DAB On (Plot #2)



NRSC AM Band Analog Compatibility Tests - Calibration Results

Tested By : DR, BM, RS NRSC Observer: Bob M.
Date Tested : 9/21/01

RF Signal Power Levels: The exciters will be set to a 1.0 MHz transmit frequency.

	Unmodulated Analog Carrier		
iDAB Exciter	Initial RF Signal Power Level (dBm)	Attenuation Added (dB)	New RF Signal Power Level (dBm)
DEV 23 - Desired	-13.16	0.90	-13.98
DEV 62 - Undesired	-13.06	1.10	-14.02

	DAB Carriers			
iDAB Exciter	Core Power Level (dBm)	Outer Enhanced Power Level (dBm)	Inner Enhanced Power Level (dBm)	Unmodulated Carrier Power
DEV 62 - Undesired	-23.8	-37.1	-41.0	-6.8

RF Spectrum: The exciters will be set to a 1.0 MHz transmit frequency.

iDAB Exciter	Unmodulated Analog Carrier Plot #	DAB On Plot #
DEV 23 - Desired	1	2
DEV 62 - Undesired	3	4

Modulation Levels: The exciters will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

iDAB Exciter	Modulation Level with Full-Scale 1 kHz Tone (%)	Modulation Level with Processed Audio Cuts (%)
DEV 23 - Desired	-100/+101	-100/+124
DEV 62 - Undesired	-100/+101	-99/+123

Audio Output Power Level & Distortion Level: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	Audio Output Power Level (Watts)	Distortion Level (%) at 100% modulation	Distortion Level (%) at 80% modulation
Delphi 9394139	-48 (Strong)			
	-62 (Moderate)			
Pioneer KEH-1900	-48 (Strong)	0.81	0.80	0.16
	-62 (Moderate)	0.70	0.94	0.32
Technics SA-EX110	-55 (Strong)			
	-69 (Moderate)			
Sony CFD-S22	-62 (Strong)	0.21	1.93	0.69
	-76 (Moderate)	0.20	2.26	0.96

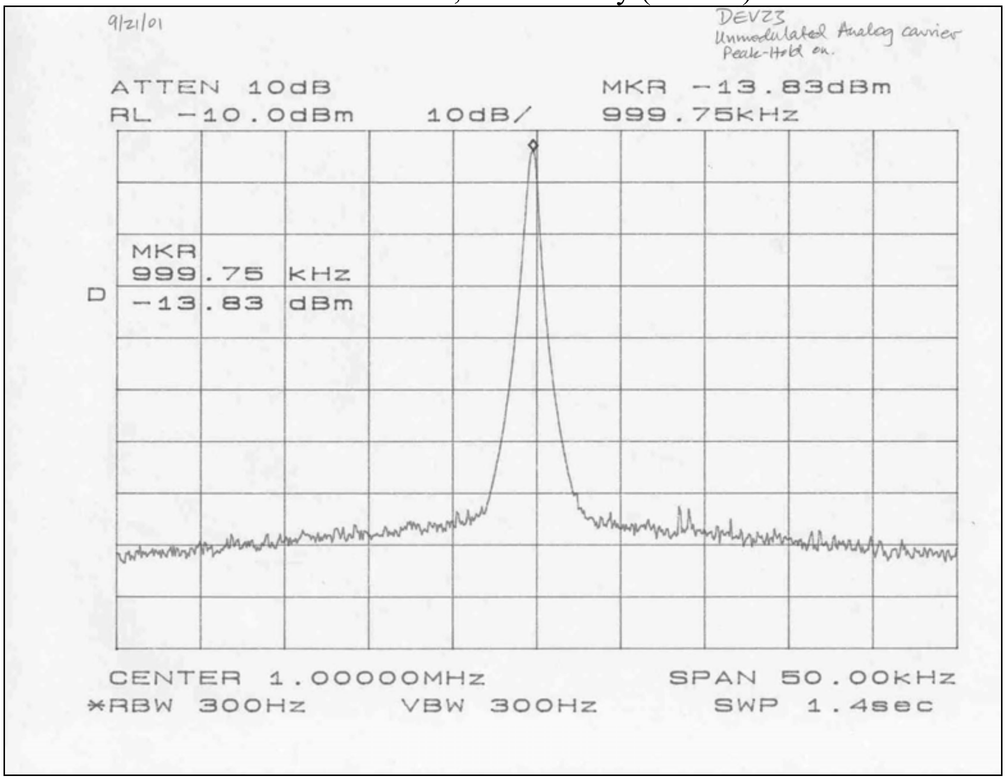
Analog SNR Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	
	-62 (Moderate)	
	-76 (Weak)	
Pioneer KEH-1900	-48 (Strong)	57.8
	-62 (Moderate)	45.1
	-76 (Weak)	31.0
Technics SA-EX110	-55 (Strong)	
	-69 (Moderate)	
	-83 (Weak)	
Sony CFD-S22	-62 (Strong)	48.9
	-76 (Moderate)	40.5
	-90 (Weak)	29.1

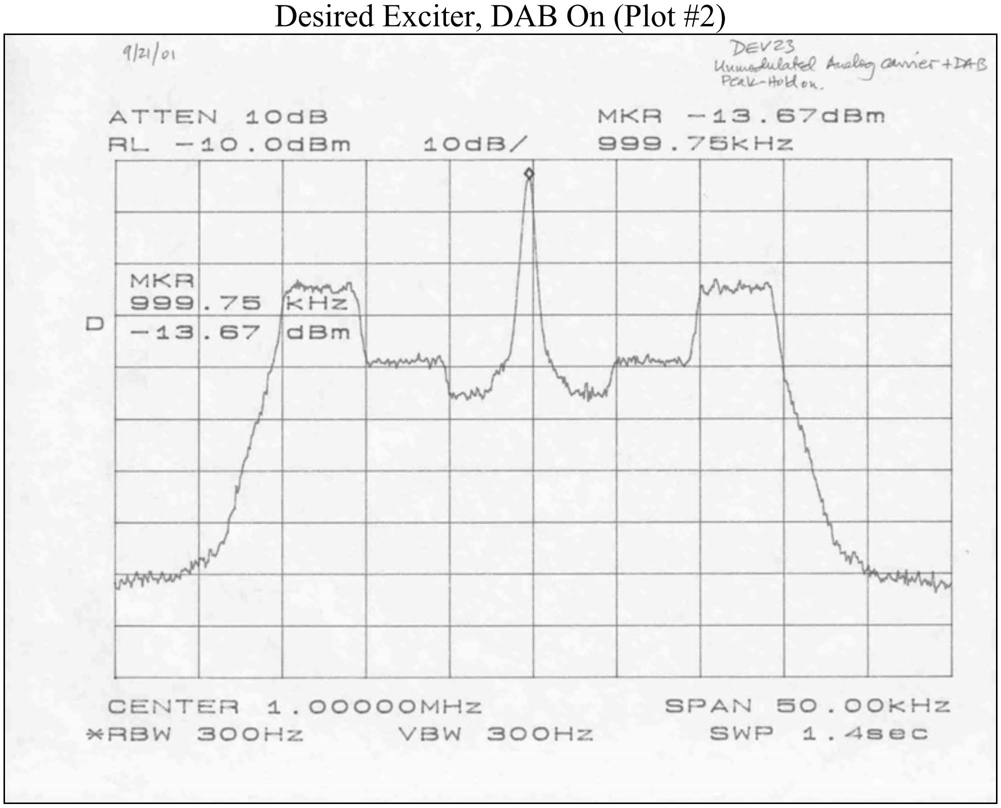
Recording Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	
Pioneer KEH-1900	-48 (Strong)	57.9
Technics SA-EX110	-55 (Strong)	
Sony CFD-S22	-62 (Strong)	48.9

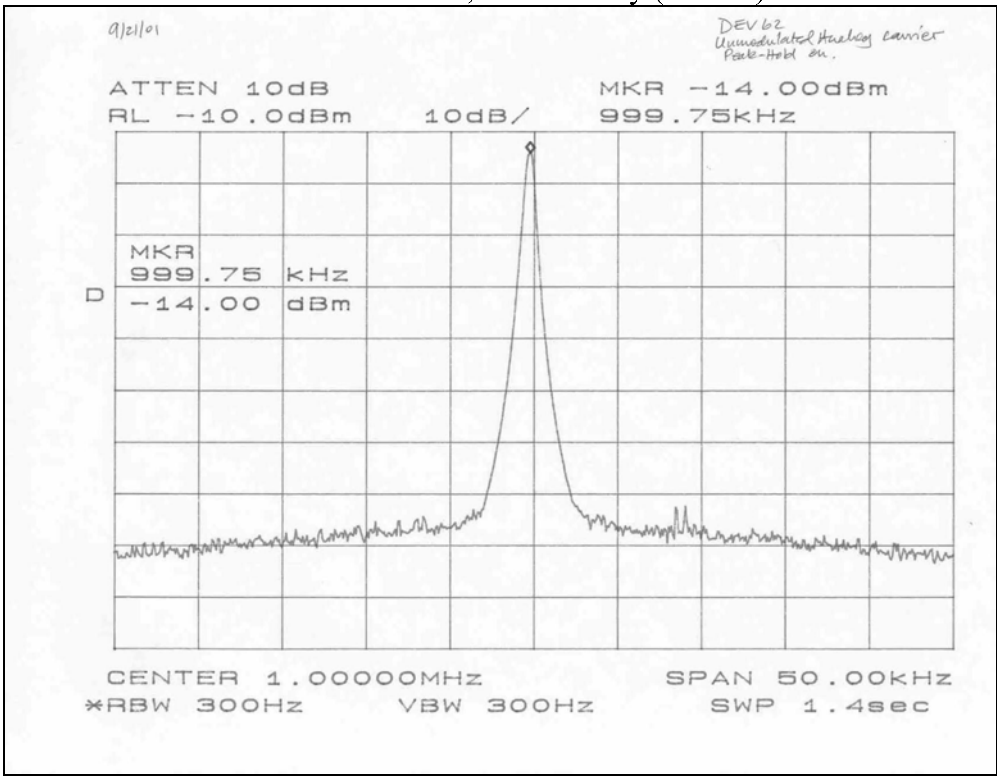
Desired Exciter, Carrier Only (Plot #1)



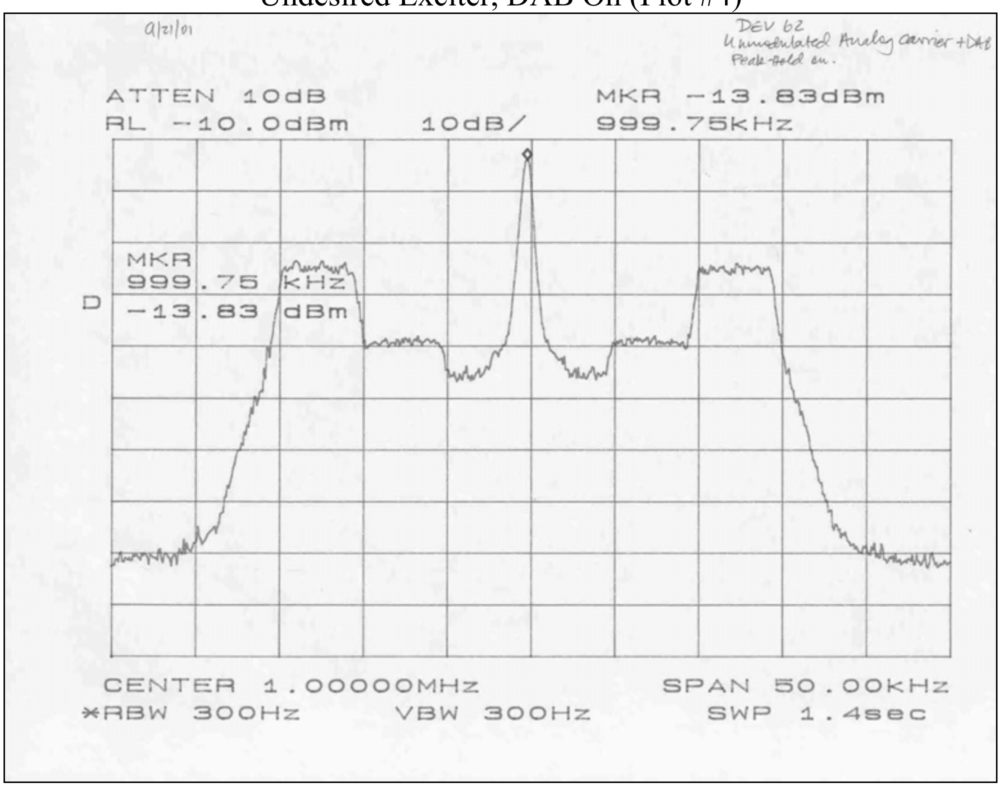
Desired Exciter, DAB On (Plot #2)



Undesired Exciter, Carrier Only (Plot #3)



Undesired Exciter, DAB On (Plot #4)



NRSC AM Band Analog Compatibility Tests - Calibration Results

Tested By : DR, BM   NRSC Observer: None
Date Tested : 10/10/01

RF Signal Power Levels: The exciters will be set to a 1.0 MHz transmit frequency.

	Unmodulated Analog Carrier		
iDAB Exciter	**Initial RF Signal Power Level (dBm)**	**Attenuation Added (dB)**	**New RF Signal Power Level (dBm)**
DEV 23 - Desired	-13.13	1.00	-14.04
DEV 62 - Undesired	-13.03	1.00	-14.03

	DAB Carriers			
iDAB Exciter	**Core Power Level (dBm)**	**Outer Enhanced Power Level (dBm)**	**Inner Enhanced Power Level (dBm)**	**Unmodulated Carrier Power**
DEV 62 - Undesired	-23.02	-36.89	-40.87	-6.68

RF Spectrum: The exciters will be set to a 1.0 MHz transmit frequency.

iDAB Exciter	Unmodulated Analog Carrier Plot #	DAB On Plot #
DEV 23 - Desired	3	4
DEV 62 - Undesired	1	2

Modulation Levels: The exciters will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

iDAB Exciter	Modulation Level with Full-Scale 1 kHz Tone (%)	Modulation Level with Processed Audio Cuts (%)
DEV 23 - Desired	-100/+101	-100/+124
DEV 62 - Undesired	-100/+101	-99/+124

Audio Output Power Level & Distortion Level: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	Audio Output Power Level (Watts)	Distortion Level (%) at 100% modulation	Distortion Level (%) at 80% modulation
Delphi 9394139	-48 (Strong)			
	-62 (Moderate)			
Pioneer KEH-1900	-48 (Strong)	0.81	0.82	0.19
	-62 (Moderate)	0.72	0.94	0.33
Technics SA-EX110	-55 (Strong)	26.1E-3	2.07	1.15
	-69 (Moderate)	18.6E-3	2.63	1.30
Sony CFD-S22	-62 (Strong)			
	-76 (Moderate)			

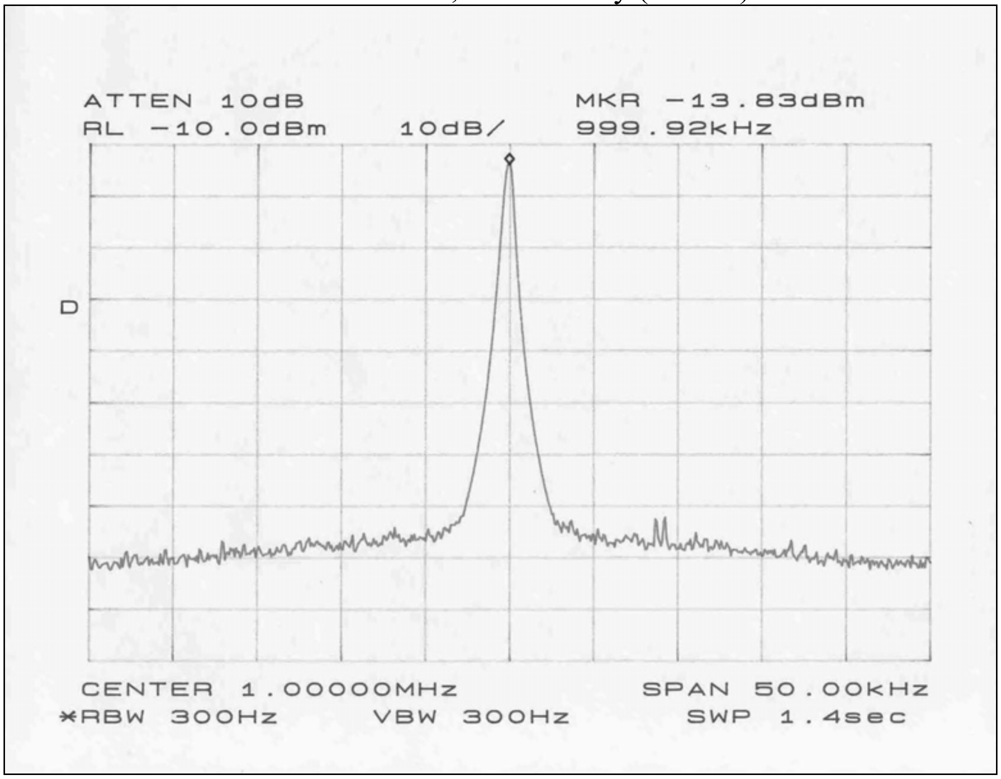
Analog SNR Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	
	-62 (Moderate)	
	-76 (Weak)	
Pioneer KEH-1900	-48 (Strong)	57.9
	-62 (Moderate)	45.1
	-76 (Weak)	31.0
Technics SA-EX110	-55 (Strong)	53.8
	-69 (Moderate)	47.2
	-83 (Weak)	34.3
Sony CFD-S22	-62 (Strong)	
	-76 (Moderate)	
	-90 (Weak)	

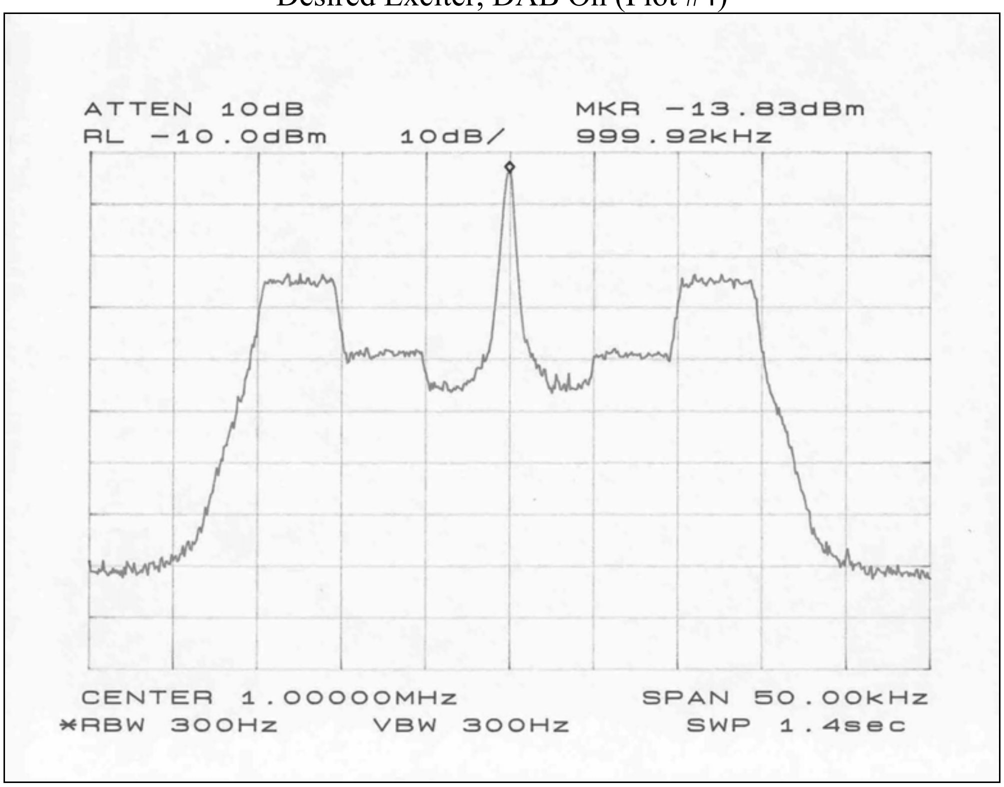
Recording Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	
Pioneer KEH-1900	-48 (Strong)	57.9
Technics SA-EX110	-55 (Strong)	53.7
Sony CFD-S22	-62 (Strong)	

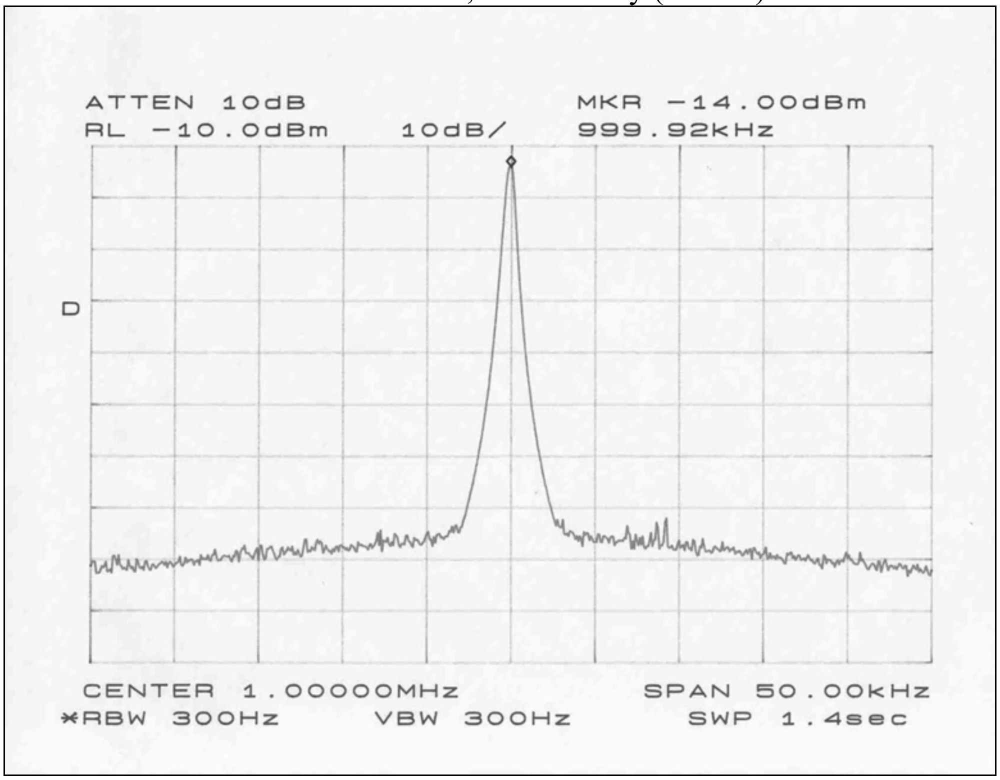
Desired Exciter, Carrier Only (Plot #3)



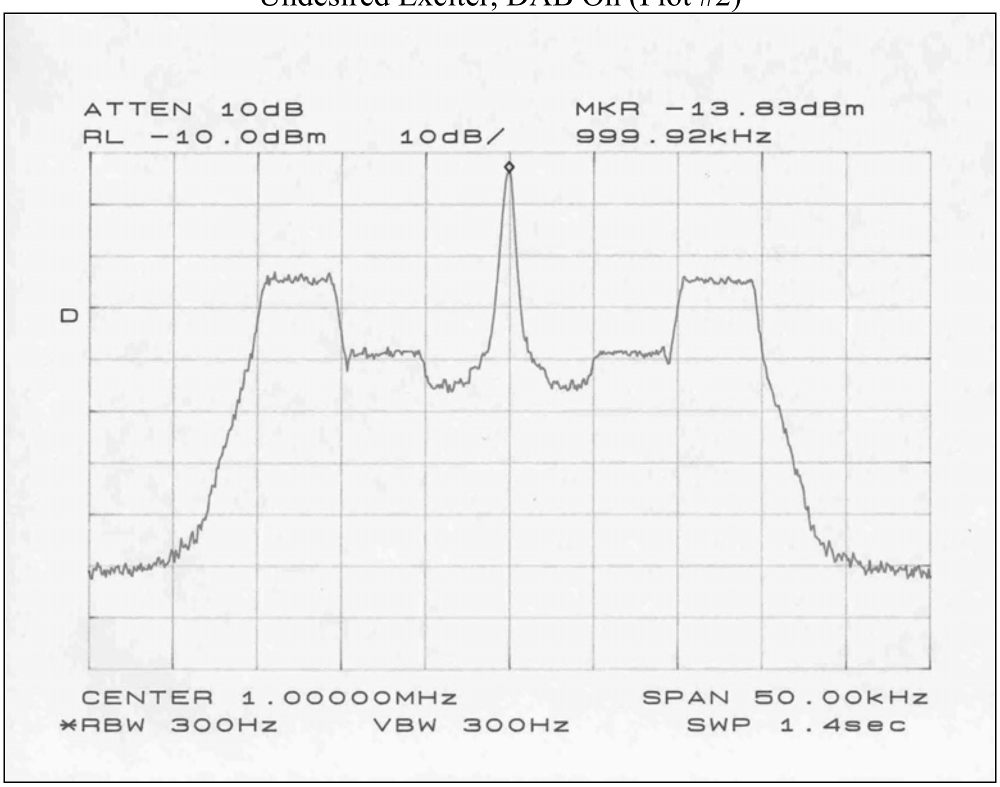
Desired Exciter, DAB On (Plot #4)



Undesired Exciter, Carrier Only (Plot #1)



Undesired Exciter, DAB On (Plot #2)



NRSC AM Band Analog Compatibility Tests - Calibration Results

Tested By : DR, BM NRSC Observer: None
Date Tested : 10/11/01

RF Signal Power Levels: The exciters will be set to a 1.0 MHz transmit frequency.

	Unmodulated Analog Carrier		
iDAB Exciter	Initial RF Signal Power Level (dBm)	Attenuation Added (dB)	New RF Signal Power Level (dBm)
DEV 23 - Desired	-13.11	1.00	-14.01
DEV 62 - Undesired	-13.02	1.00	-14.01

	DAB Carriers			
iDAB Exciter	Core Power Level (dBm)	Outer Enhanced Power Level (dBm)	Inner Enhanced Power Level (dBm)	Unmodulated Carrier Power (dBm)
DEV 62 - Undesired	-23.19	-37.02	-40.98	-6.82

RF Spectrum: The exciters will be set to a 1.0 MHz transmit frequency.

iDAB Exciter	Unmodulated Analog Carrier Plot #	DAB On Plot #
DEV 23 - Desired	3	4
DEV 62 - Undesired	1	2

Modulation Levels: The exciters will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

iDAB Exciter	Modulation Level with Full-Scale 1 kHz Tone (%)	Modulation Level with Processed Audio Cuts (%)
DEV 23 - Desired	-100/+101	-100/+124
DEV 62 - Undesired	-100/+101	-99/+123

Audio Output Power Level & Distortion Level: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	Audio Output Power Level (Watts)	Distortion Level (%) at 100% modulation	Distortion Level (%) at 80% modulation
Delphi 9394139	-48 (Strong)			
	-62 (Moderate)			
Pioneer KEH-1900	-48 (Strong)			
	-62 (Moderate)			
Technics SA-EX110	-55 (Strong)			
	-69 (Moderate)			
Sony CFD-S22	-62 (Strong)	0.21	1.88	0.63
	-76 (Moderate)	0.20	2.25	0.93

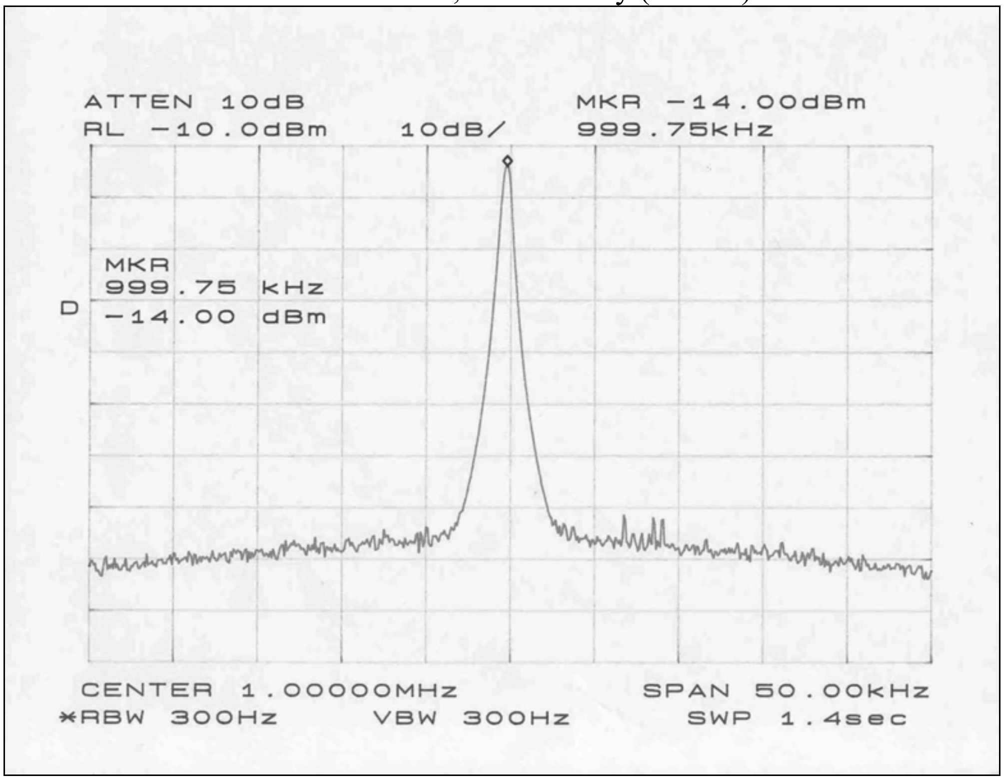
Analog SNR Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	
	-62 (Moderate)	
	-76 (Weak)	
Pioneer KEH-1900	-48 (Strong)	
	-62 (Moderate)	
	-76 (Weak)	
Technics SA-EX110	-55 (Strong)	
	-69 (Moderate)	
	-83 (Weak)	
Sony CFD-S22	-62 (Strong)	48.8
	-76 (Moderate)	40.5
	-90 (Weak)	29.0

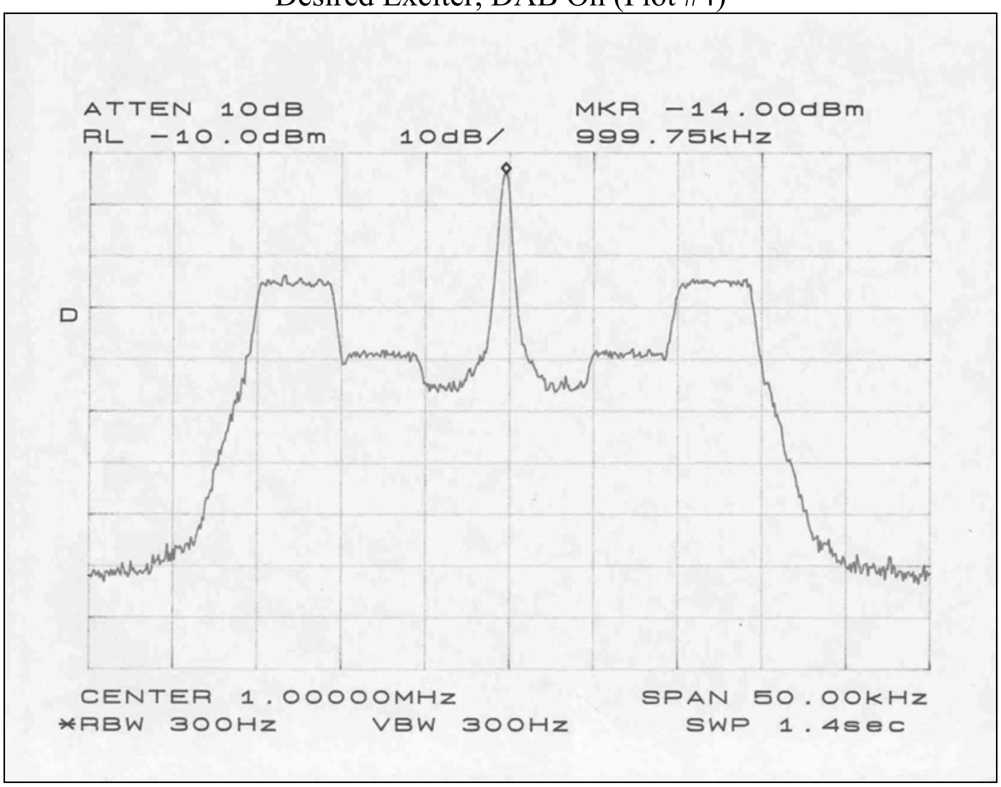
Recording Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	
Pioneer KEH-1900	-48 (Strong)	
Technics SA-EX110	-55 (Strong)	
Sony CFD-S22	-62 (Strong)	48.8

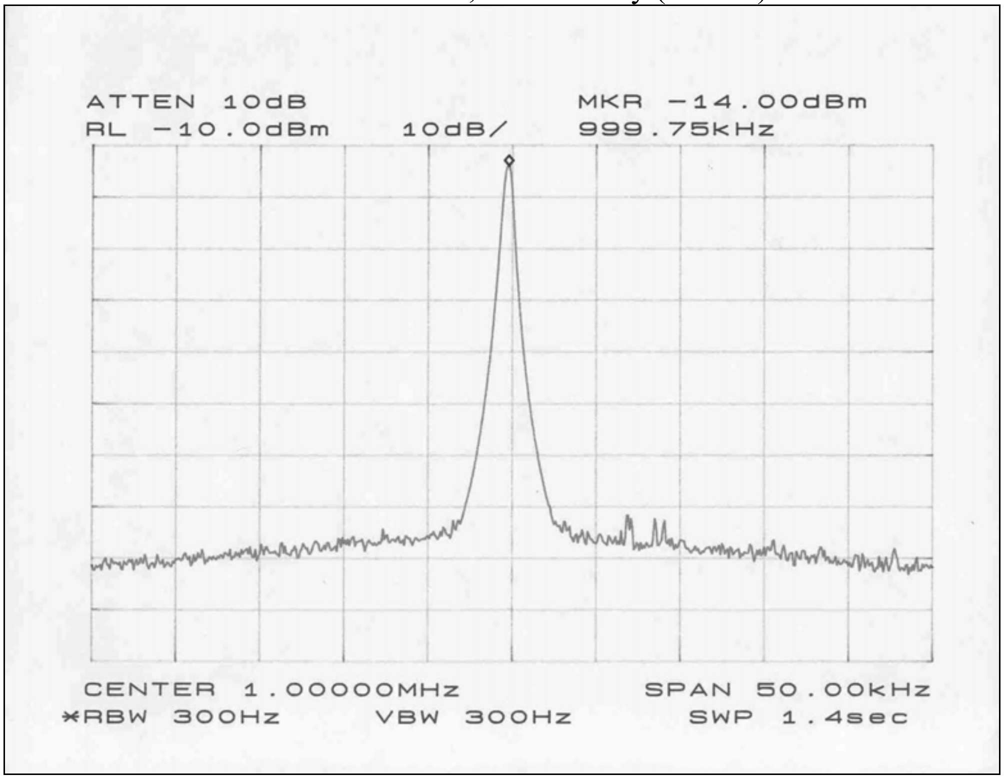
Desired Exciter, Carrier Only (Plot #3)



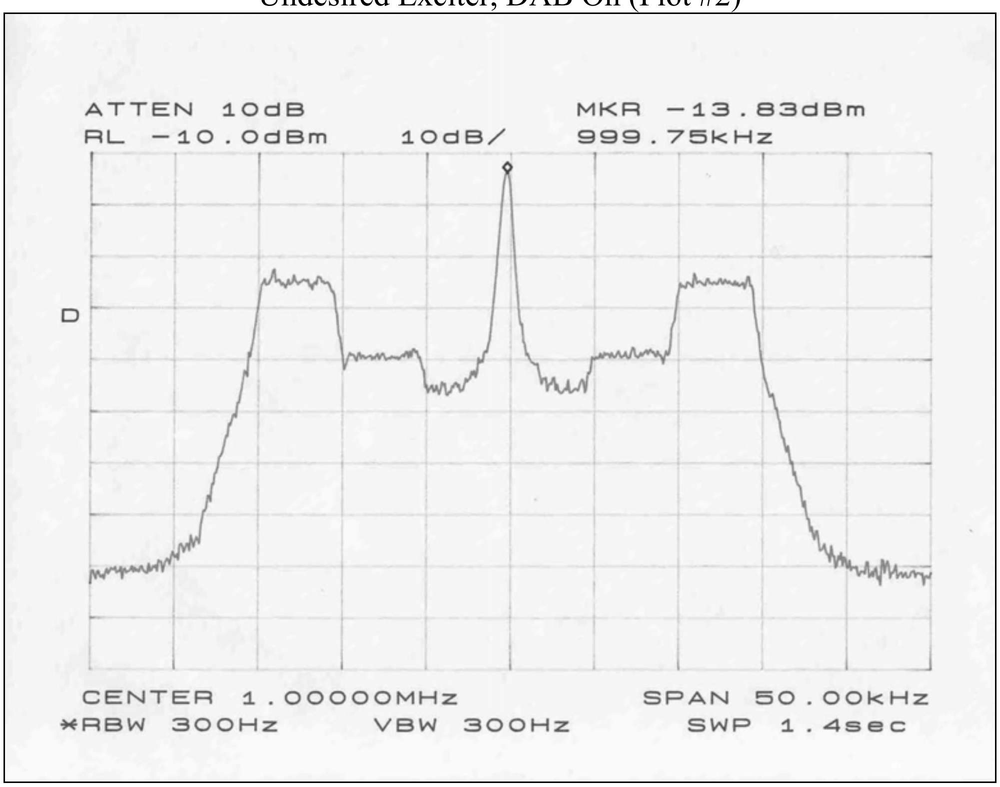
Desired Exciter, DAB On (Plot #4)



Undesired Exciter, Carrier Only (Plot #1)



Undesired Exciter, DAB On (Plot #2)



NRSC AM Band Analog Compatibility Tests - Calibration Results

Tested By : DR, BM NRSC Observer: None
Date Tested : 10/31/01

RF Signal Power Levels: The exciters will be set to a 1.0 MHz transmit frequency.

	Unmodulated Analog Carrier		
iDAB Exciter	Initial RF Signal Power Level (dBm)	Attenuation Added (dB)	New RF Signal Power Level (dBm)
DEV 23 - Desired	-13.12	1.00	-14.02
DEV 62 - Undesired	-13.04	1.10	-14.01

	DAB Carriers			
iDAB Exciter	Core Power Level (dBm)	Outer Enhanced Power Level (dBm)	Inner Enhanced Power Level (dBm)	Unmodulated Carrier Power (dBm)
DEV 62 - Undesired	-23.10	-37.09	-40.80	-6.83

RF Spectrum: The exciters will be set to a 1.0 MHz transmit frequency.

iDAB Exciter	Unmodulated Analog Carrier Plot #	DAB On Plot #
DEV 23 - Desired	1	2
DEV 62 - Undesired	3	4

Modulation Levels: The exciters will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

iDAB Exciter	Modulation Level with Full-Scale 1 kHz Tone (%)	Modulation Level with 9.5kHz Processed Music Cuts (%)
DEV 23 - Desired	-100/+101	-100/+124
DEV 62 - Undesired	-100/+101	-99/+123

Audio Output Power Level & Distortion Level: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	Audio Output Power Level (Watts)	Distortion Level (%) at 100% modulation	Distortion Level (%) at 80% modulation
Delphi 9394139	-48 (Strong)			
	-62 (Moderate)			
Pioneer KEH-1900	-48 (Strong)	0.80	0.84	0.17
	-62 (Moderate)	0.69	0.97	0.34
Technics SA-EX110	-55 (Strong)			
	-69 (Moderate)			
Sony CFD-S22	-62 (Strong)	0.21	1.83	0.60
	-76 (Moderate)	0.20	2.20	0.87

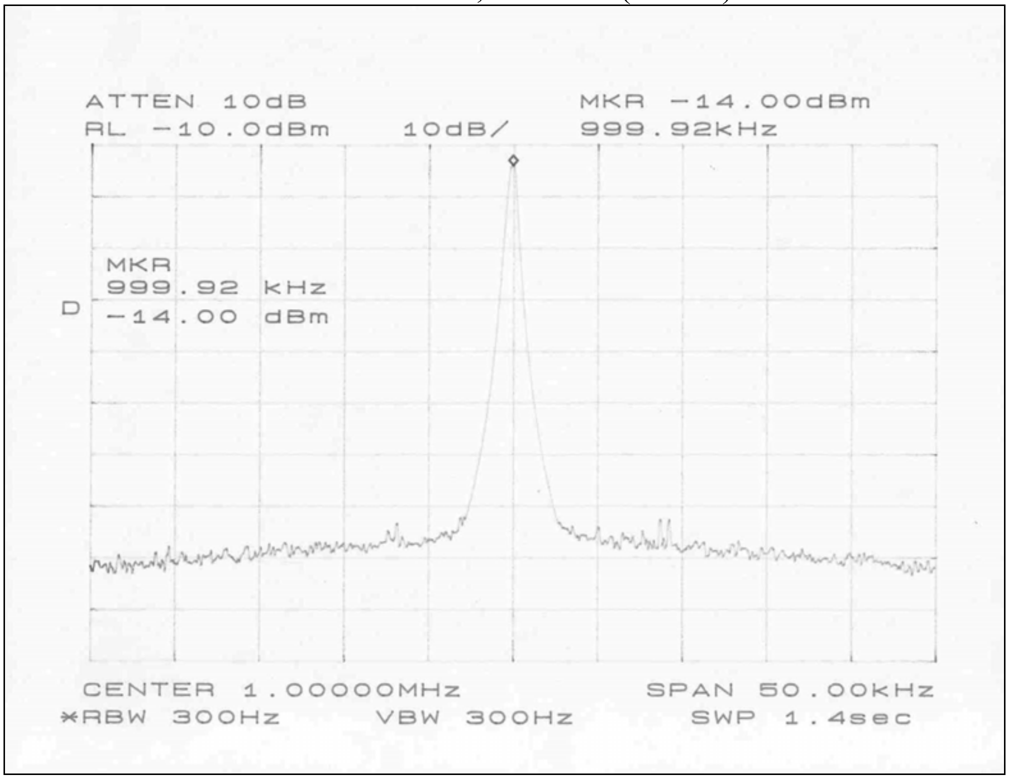
Analog SNR Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	
	-62 (Moderate)	
	-76 (Weak)	
Pioneer KEH-1900	-48 (Strong)	57.9
	-62 (Moderate)	45.1
	-76 (Weak)	31.1
Technics SA-EX110	-55 (Strong)	
	-69 (Moderate)	
	-83 (Weak)	
Sony CFD-S22	-62 (Strong)	48.7
	-76 (Moderate)	40.5
	-90 (Weak)	29.0

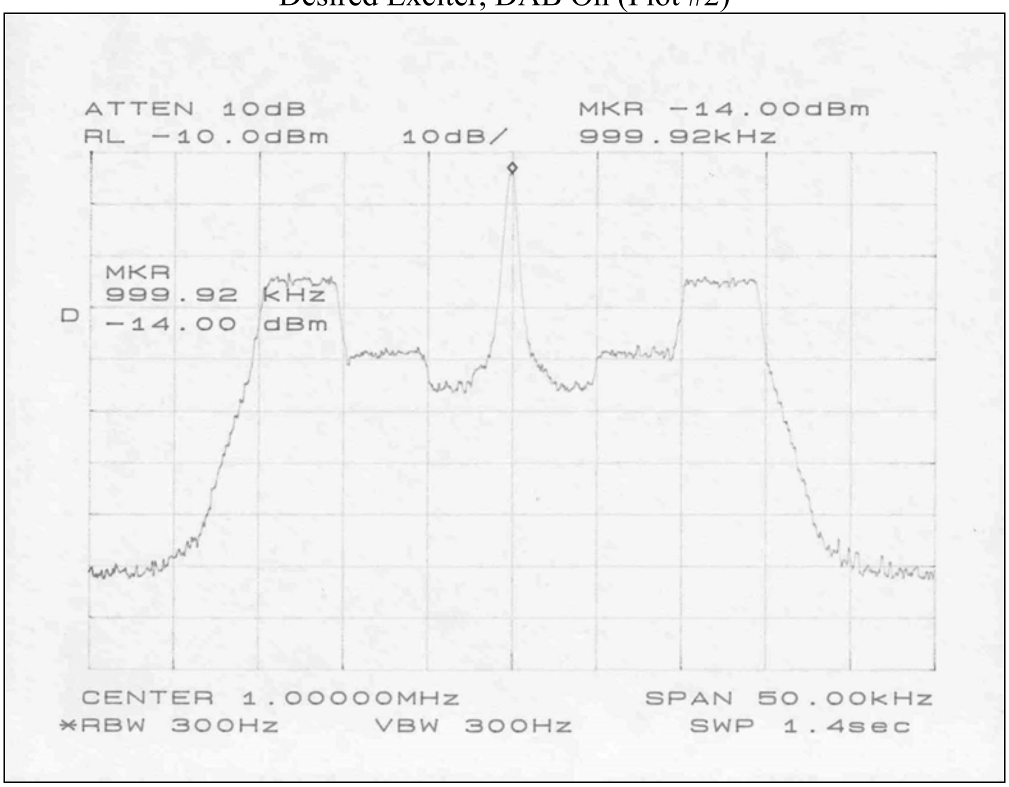
Recording Proof of Performance: The desired exciter will be set to a 1.0 MHz transmit frequency. DAB will be turned off.

Test Receiver	RF Level (dBm)	SNR (dB)
Delphi 9394139	-48 (Strong)	
Pioneer KEH-1900	-48 (Strong)	57.9
Technics SA-EX110	-55 (Strong)	
Sony CFD-S22	-62 (Strong)	48.7

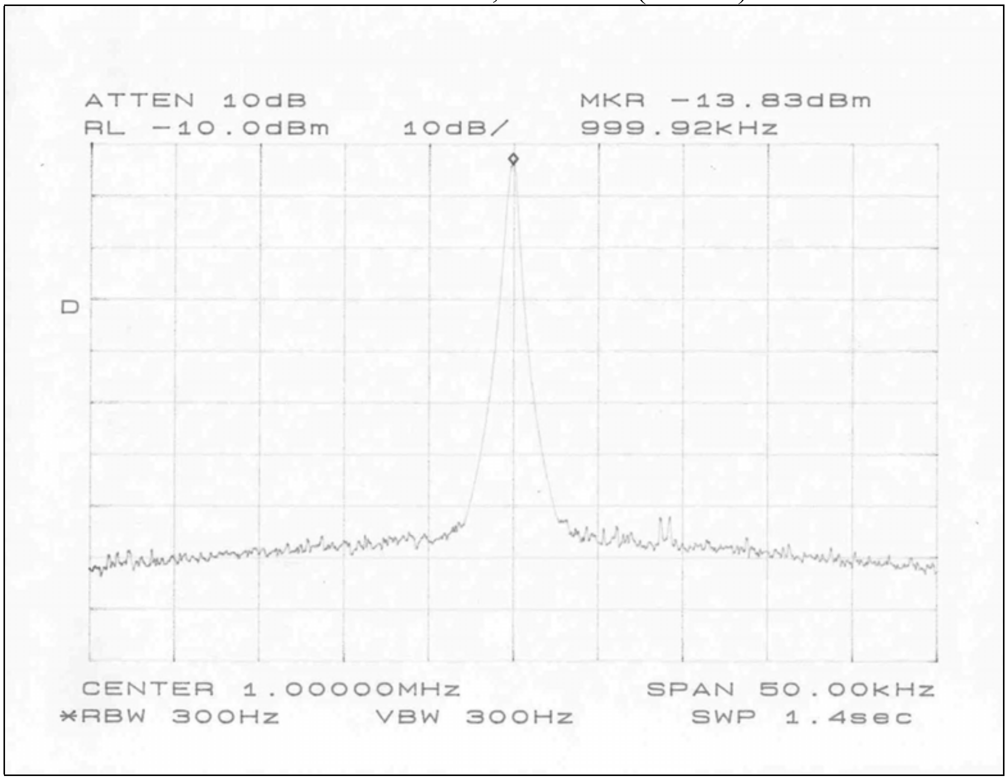
Desired Exciter, DAB Off (Plot #1)



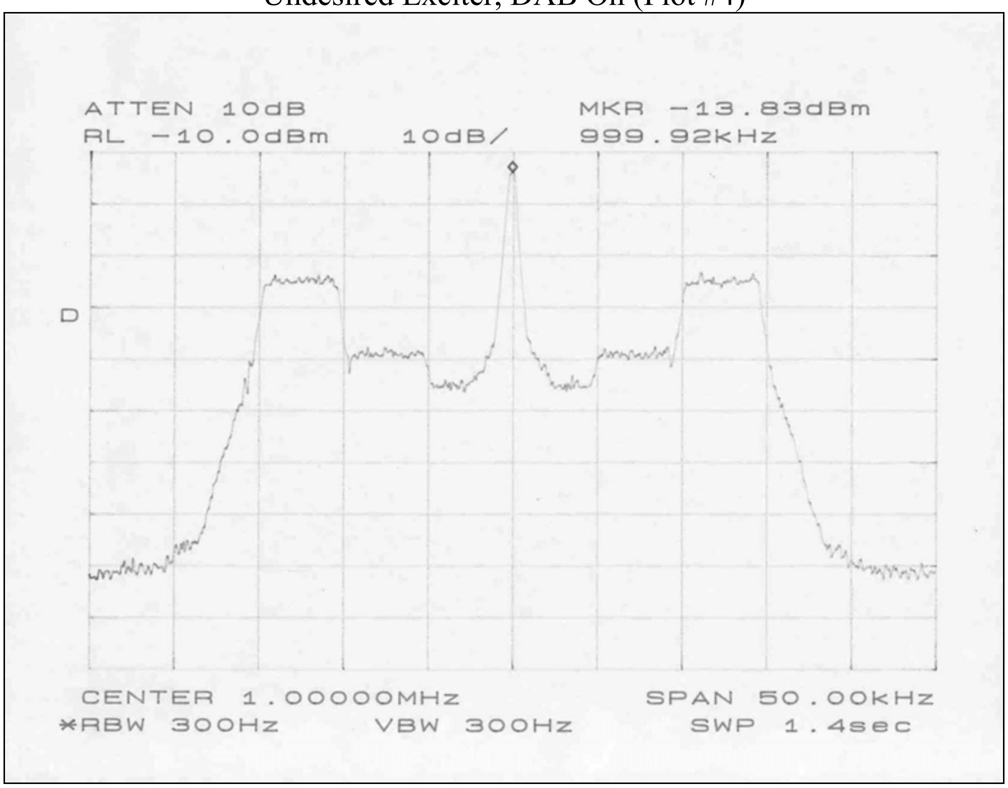
Desired Exciter, DAB On (Plot #2)



Undesired Exciter, DAB Off (Plot #3)



Undesired Exciter, DAB On (Plot #4)



Attachment C: Determination of Analog Gain Settings

Because the modulating waveforms were known prior to the testing, the precise scaling necessary to achieve +125/-100% modulation was calculated beforehand. Because the audio source is digitally fed to the exciter, the modulation percentage output by the exciter can be controlled precisely. The modulation levels were checked using the AMMA-1 Modulation Monitor, and were found to be highly predictable and repeatable.

For each processed cut used in the objective and subjective testing, the maximum and minimum samples were found using a MATLAB routine. From these values, the appropriate analog gains for achieving +125% and -100% modulation were calculated as the 1.25/max_sample and -1/min_sample, respectively. The minimum gain over all files was used in the testing, so that the modulation never exceeded -100% or +125% on any of the files.

Filename	Max Sample	Min Sample	Analog gain for +125%	Analog gain for -100%
clippinknoise_4.5khz.wav	0.835114	-0.675568	1.496802	**1.480237**
clippinknoise_9.5khz.wav	0.834808	-0.671967	1.497350	1.488169

Table 12 - Analog Gain Used in Objective Testing

The table above lists the pre-processed modulating waveforms used in the objective testing. Because the unprocessed cuts were generated in MATLAB, their contents were known exactly and therefore they were omitted from the gain calculation. The highlighted value in the table, 1.480237, was used throughout the objective testing. Use of a higher value would overmodulate the 4.5 kHz Pink Noise track. Use of a smaller value would unnecessarily undermodulate both tracks.

A similar analysis was also performed on the pre-processed tracks used in the subjective testing. The results are shown in the table on the following page. For the subjective testing, the gain-limiting track was CFemaleB2_News, with a corresponding analog gain of 1.445498. This gain setting was used throughout the subjective testing.

Filename	Max Sample	Min Sample	Analog gain for +125%	Analog gain for -100%
CBalletWoman_MusicHeavy.wav	0.835205	-0.67078	1.496638	1.490810
CNRSC_EarthWindFire_MusicHeavy.wav	0.83667	-0.67435	1.494018	1.482916
CCamera_MusicHeavy.wav	0.82724	-0.66241	1.511049	1.509629
CNRSC_Fagen_MusicHeavy.wav	0.833923	-0.67178	1.498939	1.488575
CFemaleA1_News.wav	0.830261	-0.67422	1.505550	1.483185
CNRSC_Fleetwood_MusicHeavy.wav	0.834045	-0.67435	1.498719	1.482916
CFemaleB2_News.wav	0.826447	-0.6918	1.512500	**1.445498**
CNRSC_Grant_MusicHeavy.wav	0.837891	-0.6698	1.491841	1.492983
CFemaleC10_News.wav	0.824677	-0.66852	1.515746	1.495846
CNRSC_Ibert_FineArts.wav	0.806641	-0.65146	1.549637	1.535017
CNRSC_Messiah_FineArts.wav	0.817352	-0.65509	1.529328	1.526507
CFromRichmond_9.5kHz_MusicHeavy.wav	0.831177	-0.67432	1.503892	1.482983
CNRSC_REO_MusicHeavy.wav	0.832611	-0.67065	1.501301	1.491081
CImagine_MusicHeavy.wav	0.833221	-0.67282	1.500201	1.486279
CMaleA1_News.wav	0.824097	-0.66702	1.516812	1.499199
CMaleB4_News.wav	0.822388	-0.66174	1.519964	1.511160
CNRSC_Santana_9.5kHz_MusicHeavy.wav	0.830566	-0.67578	1.504997	1.479769
CNRSC_Stansfield_MusicHeavy.wav	0.830627	-0.67953	1.504886	1.471595
CMaleC5_9.5kHz_News.wav	0.830963	-0.68054	1.504279	1.469417
CNRSC_Stravinsky_FineArts.wav	0.833893	-0.66504	1.498994	1.503671
CNRSC_Bach_FineArts.wav	0.825287	-0.66263	1.514625	1.509142
CNRSC_Travis_MusicHeavy.wav	0.827637	-0.67438	1.510324	1.482849
CNRSC_Vega_MusicHeavy.wav	0.828979	-0.67151	1.507878	1.489184
CNRSC_Carmen_9.5kHz_FineArts.wav	0.84137	-0.66913	1.485673	1.494481
CRiverdance_MusicHeavy.wav	0.833038	-0.67026	1.500531	1.491964
CNRSC_Clapton_MusicHeavy.wav	0.838318	-0.67715	1.491081	1.476768
CNRSC_Cole_MusicHeavy.wav	0.827576	-0.67368	1.510436	1.484394
CWTOPTheme_MusicHeavy.wav	0.829041	-0.66595	1.507767	1.501604
CNRSC_Debussy_FineArts.wav	0.818695	-0.65933	1.526820	1.516686
CNRSC_Santana_4.5khz_MusicHeavy.wav	0.828247	-0.66956	1.509211	1.493528
CMaleC5_4.5kHz_News.wav	0.825165	-0.66458	1.514849	1.504707
CFromRichmond_4.5khz_MusicHeavy.wav	0.83075	-0.66879	1.504665	1.495232
CNRSC_Carmen_4.5kHz_FineArts.wav	0.819611	-0.65894	1.525114	1.517599
CShania10min_4.5khz_MusicHeavy.wav	0.828094	-0.67337	1.509490	1.485067
CShania10min_9.5khz_MusicHeavy.wav	0.837982	-0.68256	1.491679	1.465081

Table 13 - Analog Gain Used in Subjective Testing

Attachment D: Theoretical DAB Power Levels

Calculations to determine the theoretical DAB carrier power levels for each of the three carrier regions are outlined below. For the sake of example, the measured RF power level of an unmodulated carrier at the exciter's output is assumed to be –6.9 dBm.

RF power level of the core carriers:

There are 25 core carriers, each at –30 dBc (dB relative to the analog carrier). Therefore, the total power in dBm is equal to:

$$\text{Power\_dBm} = 10 * \log\left(25 * 10^{\left(\frac{\text{MainCarrierLeveldBm}-30}{10}\right)}\right) = \text{MainCarrierLeveldBm} - 16.0 = -22.9\ \text{dBm}$$

RF power level of the outer enhanced carriers:

Similarly, the theoretical RF power level of the DAB outer enhanced carriers is calculated as follows:

$$\text{Power\_dBm} = 10 * \log\left(25 * 10^{\left(\frac{\text{MainCarrierLeveldBm}-44}{10}\right)}\right) = \text{MainCarrierLeveldBm} - 30.0 = -36.9\ \text{dBm}$$

RF power level of the inner enhanced carriers:

Because the inner enhanced carriers are not all at the same power level, calculation of the total power requires summation of the power of each carrier at its particular level:

$$\text{Power\_dBm} = 10 * \log\left(\sum_{i=1}^{25} 10^{\left(\frac{\text{MainCarrierLeveldBm}-P_i\text{dBc}}{10}\right)}\right) = \text{MainCarrierLeveldBm} - 33.8 = -40.7\ \text{dBm}$$

Attachment E: Calibration Documentation